8100 Modules Series

Portable, modular platform designed for the construction, validation and maintenance of optical fiber networks

User Manual

JDSU

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Manual This guide is a product of JDSU's Technical Information Development Department. This manual gives you the main information to install, start and use the 8100 Module Series.

WEE Directive Compliance JDSU has established processes in compliance with the Waste Electrical and Electronic Equipment (WEEE) Directive, 2002/96/EC.

This product should not be disposed of as unsorted municipal waste and should be collected separately and disposed of according to your national regulations. In the European Union, all equipment purchased from JDSU after 2005-08-13 can be returned for disposal at the end of its useful life. JDSU will ensure that all waste equipment returned is reused, recycled, or disposed of in an environmentally friendly manner, and in compliance with all applicable national and international waste legislation.

It is the responsibility of the equipment owner to return the equipment to JDSU for appropriate disposal. If the equipment was imported by a reseller whose name or logo is marked on the equipment, then the owner should return the equipment directly to the reseller.

Instructions for returning waste equipment to JDSU can be found in the Environmental section of JDSU's web site at www.jdsu.com. If you have questions concerning disposal of your equipment, contact JDSU's WEEE Program Management team at WEEE.EMEA@jdsu.com.

Table of Contents

About this guide

The MTS/TBERD series of JDSU provides a portable, modular platform designed for the construction, validation and maintenance of optical fiber networks.

The modules described in this document are applicable for the following platforms:

– MTS 8000
– T-BERD 8000
– MTS 6000
– T-BERD 6000

The topics discussed in this chapter are as follows:

Purpose and scope

The purpose of this guide is to help you successfully use the MTS / T-BERD features and capabilities. This guide includes task-based instructions that describe how to install, configure, use, and troubleshoot the MTS / T-BERD. Additionally, this guide provides a complete description of JDSU's warranty, services, and repair information, including terms and conditions of the licensing agreement.

Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the MTS / T-BERD effectively and efficiently. We are assuming that you are familiar with basic telecommunication concepts and terminology.

Technical assistance

If you need assistance or have questions related to the use of this product, call or e-mail JDSU's Technical Assistance Center for customer support.

Table 1 Technical assistance centers

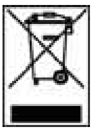
Region	Phone Number	
Americas Telecom Products	866 228 3762 World Wide: 301 353 1550	tac@jdsu.com
Europe, Africa, and Mid-East	+49 (0) 7121 86 1345 (Europe)	hotline.europe@jdsu.com
	+33 (0) 1 30 81 50 60 (JDSU France)	support.france@jdsu.com
Asia and the Pacific Southeast Asia, Australia, and New Zealand	+852 2892 0990 (Hong Kong)	
	+86 10 6833 7477 (Beijing-China)	
All others	866 228 3762	tac@jdsu.com

During off-hours, you can request assistance by doing one of the following:

– leave a voice mail message at the Technical Assistance number in your region
– e-mail North American Technical Assistance Center, tac@jdsu.com, or European Technical Assistance Center, support.uk@jdsu.com
– submit your question using our online Technical Assistance Request form at www.jdsu.com.

Recycling Information

JDSU recommends that customers dispose of their instruments and peripherals in an environnmentally sound manner. Potential methods include reuse of parts or whole products and recycling of products components, and/or materials.



Waste Electrical and electronic Equipment (WEEE) Directive

In the European Union, this label indicates that this product should not be disposed of with household waste. Il should be deposited at an appropriate facility to enable recovery and recycling.

Conventions

This guide uses naming conventions and symbols, as described in the following tables.

Table 2 Typographical conventions

Description	Example
User interface actions appear in this **typeface**.	On the Status bar, click **Start**
Buttons or switches that you press on a unit appear in this **TYPEFACE**.	Press the **ON** switch.
Code and output messages appear in this `typeface`.	`All results okay`

Table 2 Typographical conventions (Continued)

<table>
<tr><th>Description</th><th>Example</th></tr>
<tr><td>Text you must type exactly as shown appears in this <code>typeface</code>.</td><td>Type: <code>a:\set.exe</code> in the dialog box.</td></tr>
<tr><td>Variables appear in this typeface.</td><td>Type the new hostname.</td></tr>
<tr><td>Book references appear in this typeface.</td><td>Refer to Newton’s Telecom Dictionary</td></tr>
<tr><td>A vertical bar | means “or”: only one option can appear in a single command.</td><td><code>platform [a|b|e]</code></td></tr>
<tr><td>Square brackets [ ] indicate an optional argument.</td><td><code>login [platform name]</code></td></tr>
<tr><td>Slanted brackets < > group required arguments.</td><td><code><password></code></td></tr>
</table>

Table 3 Keyboard and menu conventions

Description	Example
A plus sign + indicates simultaneous keystrokes.	Press **Ctrl+s**
A comma indicates consecutive key strokes.	Press **Alt+f,s**
A slanted bracket indicates choosing a submenu from menu.	On the menu bar, click **Start > Program Files**.

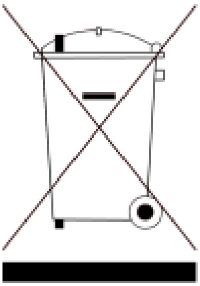
Table 4 Symbol conventions

This symbol represents a general hazard.

This symbol represents a risk of electrical shock.

NOTE

This symbol represents a Note indicating related information or tip.



This symbol, located on the equipment or its packaging, indicates that the equipment must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.

Table 5 Safety definitions

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Principles of measurement

1

This chapter gives the principles of the measurements made by the reflectometer (OTDR) plug-ins, OSA spectrum analyzers (WDM technology) and PMD analyzers (Polarization mode dispersion).

The topics discussed in this chapter are as follows:

Principle of reflectometry measurements

Optical time domain reflectometry consists in injecting a light pulse into one end of the optical fiber to be analyzed and observing, at the same end, the optical intensity passing through the fiber in the opposite direction to the propagation of the pulse.

The signal detected is exponentially diminishing in form, typical of the phenomenon of backscattering, with superimposed peaks due to reflections from the ends of the fiber or other variations in the refractive index.

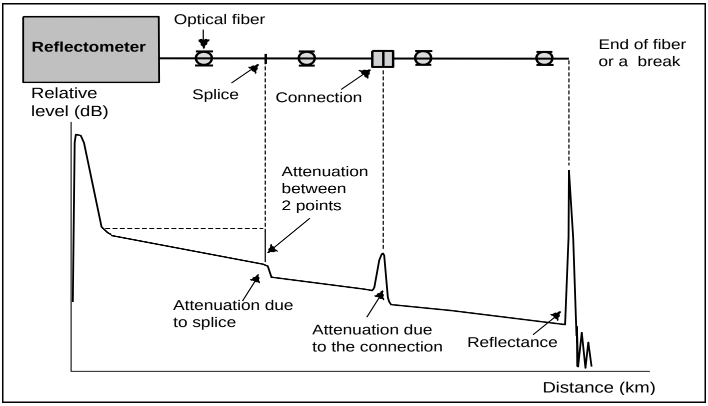


Fig. 1 Trace showing typical backscattering

Information yielded by the measurement

From a backscatter trace it is possible, in particular, to determine the position of a section of fiber within a link.

The measurement result must reveal:

- the attenuation
- the location of faults, by their distance from a point of origin,
- attenuation with respect to distance (dB/km)
- the reflectance of a reflective event or a link.

> To locate faults, a reflectometer measures only time. Consequently, group velocity must be introduced in order to determine the distance of the location. This is done by introducing the refractive index of the fiber into the instrument.

Validity of Measurement

UTI-T, in recommendations G.650, G.651 and G.652, give backscatter measurement as an alternative method for measuring attenuation, the method of reference being the cut fiber.

The field of application of backscatter is not limited, but the conditions for application of this method are nevertheless stipulated:

- injection conditions: Fresnel reflections must be limited at fiber input.
- a high-power source (laser) should be used.
- receiver bandwidth should be chosen to achieve a compromise between pulse rise time and noise level.
- backscatter power should be represented on a logarithmic scale.

Reflectance

Reflectance is a value with which the coefficient of reflection of a reflecting optical element can be quantified. It is defined as the ratio of the power reflected by the element over the incident power.

These reflections are due to variations in refractive index all along the optical link in certain telecommunications applications. If they are not controlled, they may degrade the performance of the system by perturbing the operation of the emitting laser (especially DFB lasers) or may generate interference noise in the receiver by multiple reflections.

The reflectometer is particularly well suited to the measurement of discrete reflectances on an optical fiber link. To calculate the coefficient of reflection, it is necessary to measure the total amplitude of the Fresnel reflection generated and then to apply a conversion formula to obtain the reflectance value.

This formula takes into account:

- the total amplitude of the reflection measured by the reflectometer.
- the pulse width used to measure the amplitude of the reflection (in nanoseconds)
- the backscatter coefficient of the fiber used:

– typical values of the backscatter coefficient for a pulse of 1 ns and
  - for a single-mode fiber:-79 dB to 1310 nm
  -81 dB to 1550 nm and 1625 nm
  - for a multi-mode fiber:-70 dB to 850 nm
  -75 dB to 1300 nm

NOTE

To measure the widest range of reflection coefficient, it is necessary to insert a variable optical attenuator between the reflectometer and the link to be tested. This attenuator enables the level of the trace to be adjusted so as to avoid saturation of the reflectometer by the reflection to be evaluated.

Principle of bi-directional measurement

If fibers with different mode-field diameters (core size etc.) are joined, the resulting OTDR trace waveform can show a higher backscattering level. This is due to the increased level of backscattered signal reflected back to the OTDR in the downstream fiber.

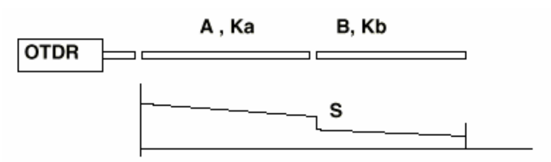
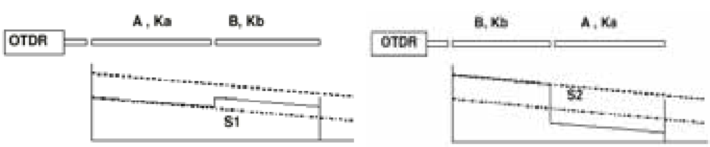


Fig. 2 Normal splice (Ka=Kb=Backscatter coefficient, S=splice value)

This phenomenon can occur when jointing different types of fiber in multi-mode or 2 fibers with different backscattering coefficients.



Ka < Kb Kb-Ka=ΔK S1=S+ΔK *Ka < Kb Kb-Ka=ΔK S2=S-ΔK*

Fig. 3

The sum gives the bi-directional or average splice loss value:

$$S = \frac{S1 + S2}{2}$$

Bi-directionnal measurement consists in performing a measurement from the extremity of fiber A, then another measurement from the extremity of fiber B, finally get events of both traces and calculate the average for all slope, splice and reflectance measurements.

Principle of WDM / OSA analysis

WDM (Wavelength Division Multiplex) technology is a very effective means of increasing the transmission of fibers, as it demands neither the installation of new links, nor any increase in transmission speed. The data are transmitted along the fiber at different wavelengths, each wavelength (or channel) transmitting a signal. The channels are defined according to the the G-692 recommendations of the ITU-T.

This technology demands new measurements, since it is important, during the installation and maintenance of WDM systems, to check the following parameters:

1. Presence of the channels at the corresponding wavelengths, with no drift
2. Correct channel power levels, without power variation
3. Satisfactory signal-to-noise ratio (SNR): its value is obtained by measuring the ratio of channel peak power to the noise power level of the ASE[1] signal to the right and/or left of the carrier. As a general rule, the noise measurement point chosen is the calculated midpoint between two adjacent channels. The noise power level measured is converted to a standard bandwidth of 0.1 nm.

The most important item of equipment for carrying out these tests on WDM systems is the optical spectrum analyzer (OSA). It can be connected at critical measurement points in the WDM system, to the ends of the links or to the amplifier locations.

1.Amplified Spontaneous Emission

Measurement results

The optical analyzer displays a spectrum representing all the channels. The measurement results are shown in the form of a complete spectrum analysis and a table of the parameters relating to each carrier.

The optical spectrum analyzer performs automatic detection and measurements on each channel.

The number of channels and the composite power are shown, and for each channel:

- the wavelength
- the interval between channels
- the power level
- the signal-to-noise ratio.

The total power of the system can also be given.

To qualify the amplifier, gain tilt and slope can be calculated. In principle, amplification should be flat right across the WDM spectrum.

DFB analysis

In order to ensure the best BER ratio, it is sometimes necessary to be able to test DFB lasers, widely used in DWDM technology.

DFB measurements are the following :

- SMSR — Side mode Suppression Ratio : the amplitude difference between the main spectral component and the largest side mode.
- Mode Offset — Wavalength separation (expressed in nm) between the main spectral component and the SMSR mode.
- Peak Amplitude — The power level of the main spectral component of the DFB laser.
- Bandwidth — Displayed bandwidth of the main spectral component of the DFB laser.

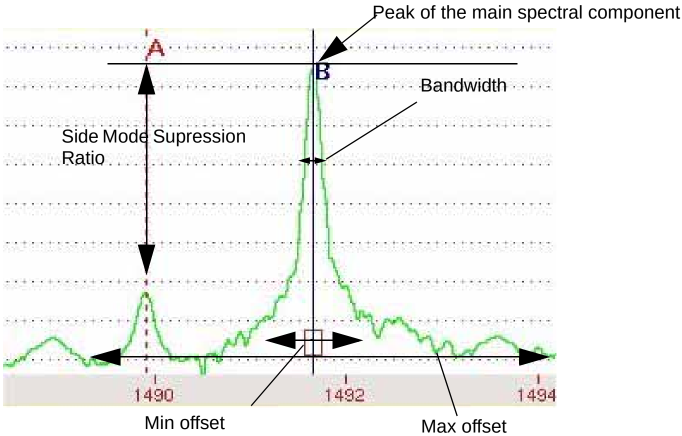


Fig. 4 DFB measurements

PMD principle

The transmission rate and range are two of the most important parameters of fiber optics paths and must therefore be optimized. And, since more and more paths (including those already installed) are being used for transmitting Wavelength Division Multiplex (WDM) signals or for bit rates of 10 Gbit/s, it is becoming all the more important to determine the Polarization Mode Dispersion (PMD).

PMD, which is the basic property of single-mode fibers, in particular affects the magnitude of the transmission rate. It results from the difference in propagation times of the energy of a given wavelength, which is split into two polarization layers that are at right angles to each other (as shown in the below diagram). The main causes of this birefringence are non-circularities of the fiber itself and external stress on the fiber (macro-bending, micro-bending, twist and temperature variations).

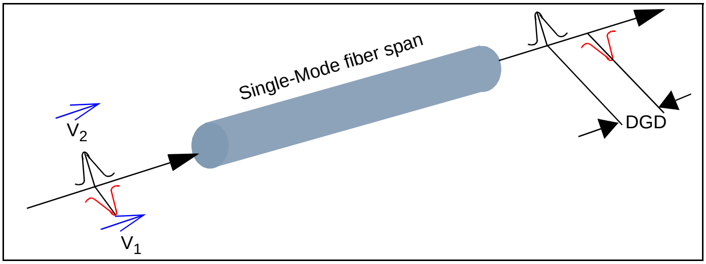


Fig. 5 Example of a time delay between two polarization layers

The PMD is also referred to as mean value of all Differential Group Delays (DGD) in picoseconds (ps) or as the DGD coefficient in ps/√km.

The mean DGD causes the transmission pulse to broaden when transmitted along the fiber, generating distortion, which in turns increases the bit-error-rate (BER) of the optical system. The consequence is that the PMD limits the transmission bit rate on a link. It is then important to know the PMD values to calculate what are the bit rate limits of the links.

Method used to measure the PMD

The method used to measure the PMD is based on the Fixed Analyzer Method[1] which requires a broadband polarized source at one extremity, and a polarized (variable) Optical Spectrum Analyzer (OSA) at the other extremity.

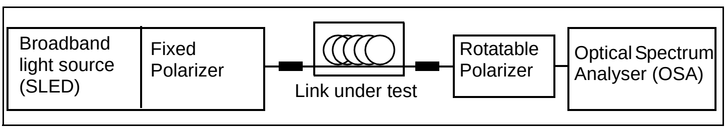


Fig. 6 Fixed Analyzer Method used to measure the PMD

The method used to measure PMD is the Fast Fourier Transform Method (FFT).

From the spectrum, the mean period of the amplitude modulation is measured.

1.This is standardized by the ANSI/TIA/EIA FOTP-113 *Polarization Mode Dispersion Measurement for Single-Mode Optical Fibers by the Fixed Analyzer Method.*

The Fast Fourier Transform Method into a time distribution will give a Gaussian curve and the mean DGD value is determined from this curve (for fiber links with strong mode coupling).

It is not necessary to modify the polarization angle of the analyzer when strong mode coupling is used. For weak mode coupling, an angle could be selected to get the maximum amplitude of the modulation.

The instrument should have a higher dynamic range than the link itself. A 35 dB dynamic range is usually enough for most of the applications, and 45 dB should be used for very long distance networks.

The measurement range of the PMD should be linked with the transmission rate. For WDM applications, it should be between 0.1 ps to 60 ps so that measurement can be carried out for bit rates between 2.5 and 40 Gbit/s. The table below indicates the maximum permitted PMD values for various bit rates.

Bit rate (Gbit/s)	**Maximum PMD (ps)**	**PMD coefficient (ps/√km)** 400 km cable length
2.5	40	< 2
10	10	< 0.5
40	2.5	< 0.125

Tables at the end of chapitre gives:

– a more complete list of the maximum PMD values for different bit rates.
– information about the appropriate standards and limits for PMD.

The principle of measurement of Chromatic Dispersion (CD)

Since more and more links (including those already installed) are being used to transmit WDM (Wavelength Division Multiplex) signals, or signals at 10 Gbit/s, it becomes very important to determine the chromatic dispersion (CD).

Chromatic dispersion (CD) is due to a variation with wavelength of the refractive index of the fiber. This results in delays in propagation for some wavelengths, which broadens the pulse transmitted along the fiber, causing consequent distortions and increasing the Bit Error Rate (BER) of the optical system.

A given speed of transmission is thus associated with a limit wavelength. And for a fiber with offset dispersion (standard G.653 ITU-T), unequal spacing of the channels around 1550 nm is imposed in order to avoid fiber non-linearities, such as the mixing of four waves.

Chromatic dispersion is defined by three principal parameters:

– delay at a given wavelength (in ps)
– the coefficient of dispersion D expressed in ps/nm. This corresponds to the drift in delay as a function of wavelength (or to the slope of the curve representing delay as a function of distance at a given wavelength). It is expressed in ps/(nm.km) if it is standardized to one km (its value is divided by the length of the fiber expressed in km).
– the slope S expressed in ps/(nm2.km). This corresponds to the drift in the coefficient of dispersion as a function of wavelength (or to the slope of the curve representing dispersion as a function of distance, at a given wavelength).

The coefficient of dispersion standardized to one km and the slope take into account the length of the fiber (which may be different from the length of the cable due to the helicoidal factor). It is therefore important to know this length with accuracy, failing which the results of the measurement will be degraded: an error of 10% in the length of the fiber will induce a 10% error in the dispersion measurement.

Chromatic dispersion is one of the most important characteristics of a fiber: it depends principally on the method of manufacture. Cable manufacturers take it into account in order to produce different types of cable designed for different applications and different needs, such as: standard fiber, offset dispersion fiber or fiber with non-zero dispersion offset.

Type of fibre/Corresponding standard	**Coefficient of dispersion at 1550 nm**
Single-mode standard/ITU-T G.652	+17 ps/(nm.km)
Single-mode offset dispersion/ITU-T G.653	0 ps/(nm.km)
Single-mode non-zero offset dispersion/ITU-T G.655	+3 ps/(nm.km)

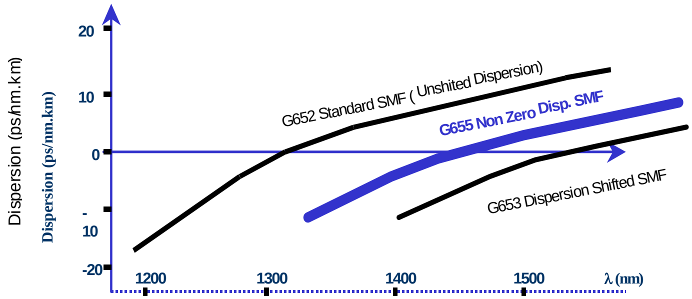


Fig. 7 Typical curves of the coefficient of distortion for different types of fibre

ITU-T standards impose measurement of the following parameters (example with G.652):

– wavelength corresponding to zero dispersion *lambda*0: this must lie between 1300 nm and 1324 nm
– slope S0 corresponding to *lambda*0: –0.093 ps/(nm2.km) max.
– two limit values of the coefficient of dispersion at wavelengths situated between 1260 nm and 1360 nm.

Chromatic dispersion is not dependent on the time and constraints of installation, and it is relatively insensitive to variations in temperature:

– 0.0025 ps/(nm.km.°C) for the coefficient of dispersion
– 0.0025 ps/(nm2.km.°C) for the slope

The only external parameter that can affect it is the type of modulation of the signal itself (most type DFB lasers have no external modulation to limit this effect).

Chromatic dispersion analyzers give the delay value of the optical link unit as a function of wavelength. On the basis of this delay, they calculate the coefficient of dispersion, the dispersion slope and specific values such as the wavelength corresponding to zero dispersion and the associated slope.

The principle of measurement of chromatic dispersion is described in document IEC 60793-1-42, as well as in ITU-T recommendations G.650 and G.652.

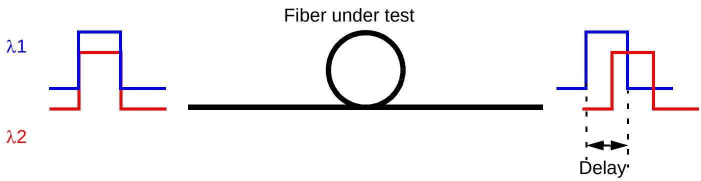
The calibration of the instrument is defined in document IEC 61744.

Telcordia has also published "GR-761-CORE requirements for chromatic dispersion analyzers".

Method of CD measurement used by the Base Unit

There are different methods for measuring chromatic dispersion.

The Base Unit measures the delay of propagation of pulses along the fiber due to specific reflective events such as connectors (Fresnel), doing this for four wavelengths: 1310, 1480, 1550 & 1625 nm. One of these 4 measurements is chosen as a reference for calculation of delays.



On the basis of the 4 results obtained, the Base Unit defines the curve representing the delay as a function of wavelength by using one of the following numerical approximation algorithms:

- Quadratic: A+Bλ+Cλ2 (parabolic curve).
- Sellmeier 3-term: A+Bλ2+Cλ–2
- Sellmeier 5-term: A+Bλ2+Cλ–2+Dλ4+Eλ–4

It then calculates the drift of this curve in order to obtain the coefficient of dispersion D as a function of wavelength.

It then calculates the drift of this last curve in order to obtain the dispersion slope.

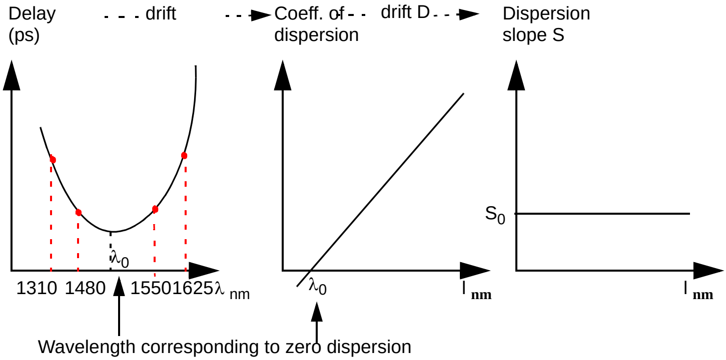


Fig. 8 Example of curves obtained by quadratic approximation

Principle of optical power and attenuation measurements (OFI)

Power measurement

A power meter, is all that is needed to measure emitted or received power:

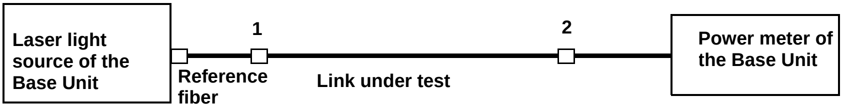
– to measure emitted power, connect the power meter directly to the output of the optical emitter;

– to measure the power at the input of an optical receiver, the power meter is connected to the end of the fiber, at the point where the optical receiver would be connected.

Attenuation measurements (optical link loss)

For measurement of the attenuation of power in a complete link or in elements such as sections of fiber, connections or optical components, a light source and a power meter are required.

This attenuation is usually deduced from the measurement of optical power at two points:



Attenuation $A_{(dB)} = P1_{\ (dBm)} - P2_{\ (dBm)}$

To perform accurate measurements, the following conditions are vital

- Use one of the light sources of the LTS or a light source which is stable both in time and as a function of temperature.
- Make sure that all connections and fibers and the receiving cell are perfectly clean.
- Use a reference link between the laser source and the test subject. If several measurements are to be made under identical light injection conditions, this reference fiber must not be disconnected during the period while measurements are taking place.

Insertion loss method

1 The power meter is first connected to the laser source via the reference fiber: P1 is measured.

2 Then the fiber to be tested is inserted between the reference fiber and the power meter: P2 is measured.

The difference between P2 and P1 gives the attenuation of the fiber under test.

It is preferable to use the same type of connector at both ends of the fiber being tested, to ensure the same connection conditions for measuring P1 and P2.

Standards and λ0 for different types of fiber

Fibre	**non-offset dispersion**	**offset dispersion**	**non-zero or homogeneous offset dispersion**
Standard ITU/Y	ITU-T G.652	ITU-T G.653	ITU-T G.655
Standard IEC	IEC 60793-1-1 type B1	IEC 60793-1-1 type B2	IEC 60793-1-1 type B3
Standard TIA/EIA	Iva	IVb	IVb
Approximate λ_0 .	1310 nm	1550 nm	1500 nm or indefinite

Most suitable method of approximation according to trace zone

Fibre	**non-offset dispersion**	**offset dispersion**	**non-zero or homogeneous offset dispersion**
1310 nm zone	Sellmeier 3-term	Sellmeier 5-term	Sellmeier 5-term
1550 nm zone	Sellmeier 5-term	Quadratic	Sellmeier 5-term
Complete curve	Sellmeier 5-term	Sellmeier 5-term	Sellmeier 5-term

Getting started

2

The topics discussed in this chapter are as follows:

Adapting MTS 5000 series plug-ins

The plug-ins of the MTS 5000 series are shorter than those of the 8100 series. Before they can be used in the Base Unit, an extension must be fitted:

– ref. E50OTDRext for OTDR plug-ins

– E507Xext for WDM plug-ins.

To attach this extension:

– remove the two screws on the plug-in marked "a" below.

– connect the extension to the rear of the plug-in and fix the screws back in.

– stick the adhesive label supplied with the extension on to the upper surface of the assembly the hold the two elements securely together.

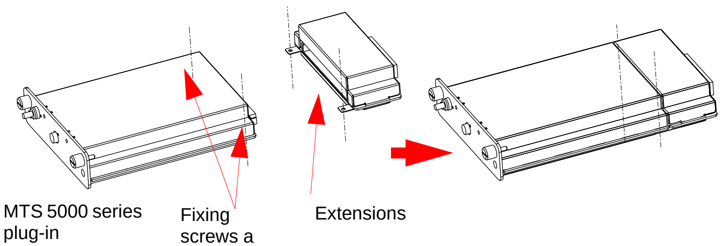


Fig. 9 Mounting the extension on a MTS 5000 series plug-in

Installing a plug-in in a receptacle and removing it

A plug-in may be inserted into either of the two slots provided for the purpose.

When a slot is vacant, it is closed by means of a cover-plate fitted with two captive screws like those on the plug-ins.

Fig. 10 Rear view of the Base Unit (example)

Removing a plug-in from a receptacle

> The Base Unit must be switched off, and if it has a mains power supply, the adapter cable must be unplugged.

1 Completely unscrew (up to the stop) the two captive screws securing the plug-in.
2 Carefully slide the plug-in out of its slot.

Inserting a plug-in into receptacle

> The Base Unit must be switched off, and if it has a mains power supply, the adapter cable must be unplugged.

1 Slide the plug-in into its slot.
2 When it is fully home, press against the screen-printed surface of the plug-in while tightening the the securing screws. The screen-printed surface of the plug-in must be flush with that of the receptacle.
3 Make sure that the two large captive screws of the plug-in are screwed fully home.

NOTE

UHD plug-ins use very powerful lasers : they must be connected exclusively to optical connectors equiped with zirconium ferules. Using connectors equiped with metallic ferrules could damage the plug-in connector.

Universal connectors and adapters

Fiber Optic plug-ins may come equipped with a universal connector and adapter selected at time of order.

Adapter types

JDSU offers 5 different adapters, all compatible with this connector, allowing the user to switch from one adapter to another according to which fiber type he intends to work with.

Adapter types supplied are : FC, SC, DIN, ST and LC.

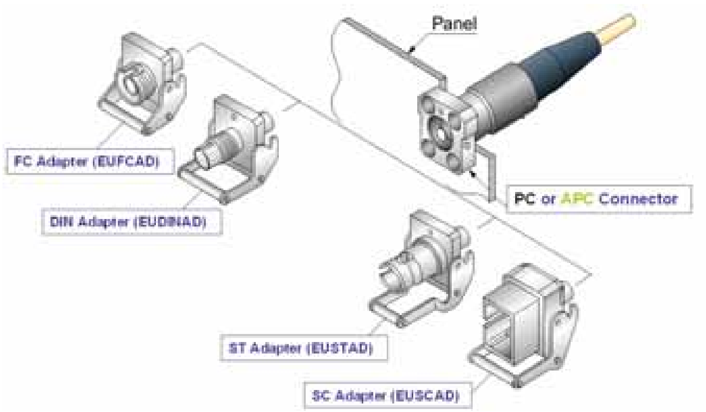


Fig. 11 5 different types of adapters may be mounted on the universal connector

Switching adapter type

In order to switch from an adapter to another, proceed as shown.

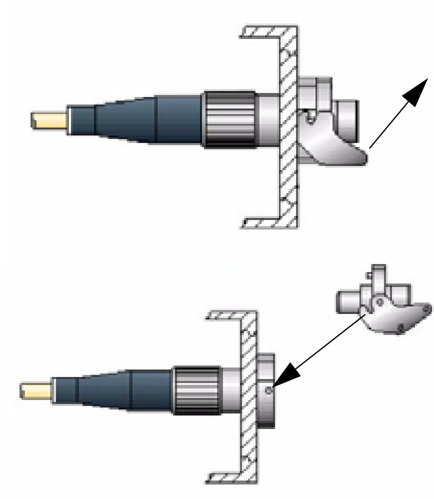


Fig. 12 Removing and refitting an adapter

Cleaning the universal connector

Remove the adapter in order to access the ferrule and clean it using a cotton swab.

Installing a new version of the software

> When a new software version is loaded, there is a risk of re-initialization of the internal memory. Before installing the new software, it is therefore advisable to to save the results in the memory, using the **Save** function in the **Memory** menu called up by the **FILE** button.

> Do not interrupt the installation process, as this could damage the instrument.
>
> To avoid any interruption of the installation procedure, the Base Unit must be operating on the mains: if the procedure is started while operating on battery, a message indicates that the instrument must be connected to the mains.

Where and how to obtain the new software

The new version of the software can either be procured on a storage medium (CD-ROM, USB stick memory or CompactFlash memory card) from your JDSU Customer Service, or can be downloaded from JDSU's internet site: www.jdsu.com.

Downloading from Internet

When the software is obtained from the Internet, it must be saved on a storage medium before the software upgrade of the product can be carried out. To do this, on the JDSU web site, open the file entitled **README.txt** in the folder where the download is located and follow the instructions it contains.

> **NOTE**
>
> Once the upgrade has been loaded from Internet, the new version cannot be burned with the CD ROM of the MTS / T-BERD Base Unit. Burn the CD-ROM of the PC, using CD burner softwares recommended by JDSU .

Installation from a PC

The new versions can be installed according 2 methods:

– from the harddisk of a PC
– from the CD-ROM drive of a PC

Installation from the harddisk of a PC

1 Connect the MTS / T-BERD Base Unit into mains with the AC plug, and switch it on.

2 Connect the MTS / T-BERD Base Unit to the PC by an Ethernet link

> **NOTE**
>
> Use a cross over if the Base Unit is directly connected to the PC or a direct cable if the Base Unit is connected to the LAN.

3 On the PC, unzip the upgrade file in a directory, such as `C:/8000_Base_Upgrade/`

4 Open a DOS console, by selecting **Windows > Start** (bottom right of the PC screen) **> All programs > Accessories > Command prompt.**

5 Then type the command `subst N: C:\upgrade\`

6 Close the DOS console.

This command will create a virtual drive `N:` (N: is an example)[1]

7 Run ***TFTPD32.exe***: note the «Server Interfaces» address which appears in the TFTPD32 window.

8 Run ***FTP server.exe***. An error message will appear: click on **OK**.

The window «Pablo's FTP server» is displayed. Click on the green arrow (or select menu **File > Start)**.

9 On the Base Unit, press the **SYSTEM** key, then System Menu: in **Utility > Upgrade Parameters > Server adress**, enter the IP address previously noted (see "7" above).

10 Quit the **System** menu and then press, in succession, **Expert Tools > Software Upgrade > From Ethernet**.

The message «Indicate IP address of PC server» appears.

11 Click on **Confirm**.

The list of the software versions available on the PC is displayed next to the versions installed on the Base Unit.

↑ More recent version on the PC than on the Base Unit

↓ Less recent version on the PC than on the Base Unit

= Identical version on the PC and on the Base Unit

12 Click on **Previous choice** or **Next Choice** to display the previous and next versions available.

13 Click on **Confirm** to start the upgrade of the selected software(s).

1."N:" may be replaced by another letter if necessary and "8000_Base_Upgrade" corresponds to the directory where the updrade files have been unzipped.

NOTE

The software versions list does not always appear (cf previous versions) as well as the **Previous / Next Choice** buttons and the **Confirm/Continue** key. In this case, the upgrading starts automatically.

Upgrading begins. The Base Unit is automatically rebooted. Upgrading takes several minutes. At the end, the Base Unit is automatically restarted (if the boot version is superior to version 01.16).

14 On the PC, close the two windows opened to perform the installation.

15 Once the upgrade is completed, you may remove the virtual drive (in our example "N:") by using the command `subst N: /d.`

Installation from the CD-ROM drive of a PC

1 Connect the Base Unit into mains with the AC plug, and switch it on.

2 Connect the Base Unit to the PC by an Ethernet link

NOTE

Use a cross over if the Base Unit is directly connected to the PC or a direct cable if the Base Unit is connected to the LAN.

3 Insert the CD-ROM in the drive of the PC.

4 On the PC, use Windows Explorer to open the CD-ROM.

5 Run ***TFTPD32.exe***: note the «Server Interfaces» address which appears in the TFTPD32 window.

6 Run ***FTP server.exe***. An error message will appear: click on **OK**.

The window «Pablo's FTP server» is displayed. Click on the green arrow (or select menu File > Start).

7 On the Base Unit, press the **SYSTEM** key, then **System Menu:** in **Utility > Upgrade Parameters > Server adress**, enter the IP address previously noted (see "5" above).

8 Quit the **SYSTEM** menu and then press, in succession, **Expert Tools > Software Upgrade > From Ethernet**.

The message Indicate IP address of PC server appears.

9 Click on **Continue**.

The list of the software versions available on the PC is displayed next to the versions installed on the Base Unit.

10 Click on **Previous choice** or **Next Choice** to display the previous and next versions available.

11 Click on **Confirm** to start the upgrade of the selected software(s).

> **NOTE**
>
> The software versions list does not always appear (cf previous versions) as well as the **Previous / Next Choice** buttons and the **Confirm/Continue** key. In this case, the upgrading starts automatically.

Upgrading begins. The Base Unit is automatically rebooted. Upgrading takes several minutes. At the end, the Base Unit is automatically restarted (if the boot version is superior to version 01.16).

12 On the PC, close the two windows opened to perform the installation.

Installation from Ethernet

Before starting the software upgrade via Ethernet, make sure the IP adress of the PC server.

1 Press, in succession, **Expert Tools > Software Upgrade > From Ethernet**.

The message Indicate IP address of PC server appears.

2 Click on **Continue**.

The list of the software versions available on the PC is displayed next to the versions installed on the Base Unit.

3 Click on **Previous choice** or **Next Choice** to display the previous and next versions available.

4 Click on **Confirm** to start the upgrade of the selected software(s).

> **NOTE**
>
> The software versions list does not always appear (cf previous versions) as well as the **Previous / Next Choice** buttons and the **Confirm/Continue** key. In this case, the upgrading starts automatically.

Upgrading begins. The Base Unit is automatically rebooted. Upgrading takes several minutes. At the end, the Base Unit is automatically restarted (if the boot version is superior to version 01.16).

Installation from a CD-ROM (MTS / T-BERD 8000 only)

Updating from a CD-ROM can be done directly, if the Base Unit is equipped with a CD-ROM drive.

1. Connect the Base Unit into mains with the AC plug, and switch it on.
2. Insert the CD-ROM in the drive of the Base Unit.
3. Press the **SYSTEM** key and then, in succession, the keys **Expert Tools > Software Upgrade > Copy from CD**.

   The message Insert the CD in the drive is displayed
4. Click on **Confirm**.

   The list of the software versions available on the PC is displayed next to the versions installed on the Base Unit.
5. Click on **Previous choice** or **Next Choice** to display the previous and next versions available.
6. Click on **Confirm** to start the upgrade of the selected software(s).

> **NOTE**
>
> The software versions list does not always appear (cf previous versions) as well as the **Previous / Next Choice** buttons and the **Confirm/Continue** key. In this case, the upgrading starts automatically.

Upgrading starts. The Base Unit is automatically rebooted. The installation process takes several minutes. At the end, the Base Unit is automatically restarted (if the boot version is superior to version 01.16).

Installation from a CompactFlash memory card (MTS / T-BERD 8000 only)

You must be equipped with a CompactFlash memory card with a minimum capacity of 128 Mo.

1. Switch off and unplug your Base Unit.
2. Insert the CompactFlash memory card in which the new unzipped software has been loaded, into the slot on the Base Unit provided for this purpose.
3. Connect the Base Unit into mains with the AC plug and switch it on.
4. Press the **SYSTEM** button, then successively **Expert tools > Software Upgrade > Copy from CF**.
5. Click on **Confirm**.

   The list of the software versions available on the PC is displayed next to the versions installed on the Base Unit.

6 Click on **Previous choice** or **Next Choice** to display the previous and next versions available.

7 Click on **Confirm** to start the upgrade of the selected software(s).

NOTE

The software versions list does not always appear (cf previous versions) as well as the **Previous / Next Choice** buttons and the **Confirm/Continue** key. In this case, the upgrading starts automatically.

Upgrading begins. The Base Unit is automatically rebooted. Upgrading takes several minutes. At the end, the Base Unit is automatically restarted (if the boot version is superior to version 01.16).

Installation from a USB memory stick

You must be equipped with a USB memory stick with a minimum capacity of 128 Mo.

Only one USB memory key should be plugged in the unit at any one time.

If you wish to use a second USB key (even if it is from the same manufacturer), then you must fully reboot the unit. (i.e. power down and remove external power if it was present).

Before installing the upgrade, you must format the USB memory stick (steps 1 to 5).

1 Insert the memory stick into one of the sockets on the Base Unit provided for this purpose.

2 Switch on the Base Unit

3 Press the **SYSTEM** button

4 Successively select **Expert tools** > **Media utilities** > **Usbflash Format.**

5 Confirm your choice to actually format the USB memory stick.

As for any media formatting, please note that all data present on the USB memory stick will be irremediably lost.

6 Connect the USB memory stick to the PC

7 Unzip the upgrade files on the PC and transfer it to the USB memory stick.

8 Insert the memory stick, into one of the sockets on the Base Unit provided for this purpose.

> **NOTE**
>
> A bip is emitted each time the USB memory stick is inserted or removed from the Base Unit.

9 Press the **SYSTEM** button, then successively the buttons **Expert tools > Software Upgrade > Copy from USB**.

The message Are you sure? is displayed

10 Click on **Confirm**.

The list of the software versions available on the PC is displayed next to the versions installed on the Base Unit.

11 Click on **Previous choice** or **Next Choice** to display the previous and next versions available.

12 Click on **Confirm** to start the upgrade of the selected software(s). Remove the key and insert it again when requested.

> **NOTE**
>
> The software versions list does not always appear (cf previous versions) as well as the **Previous / Next Choice** buttons and the **Confirm/Continue** key. In this case, the upgrading starts automatically.

Upgrading begins. The Base Unit is automatically rebooted. Upgrading takes several minutes. At the end, the Base Unit is automatically restarted (if the boot version is superior to version 01.16).

Graphical User Interface

3

This chapter describes the graphical user interface of the Base Unit used with the optical measurement plug-ins (OTDR, WDM, etc.).

The topics discussed in this chapter are as follows:

Display screen

The display screen is divided into a number of different zones. Starting from the top, these are:

– a status bar in which various icons indicate the current functions:
– a bar displaying a scaled-down representation of the trace, showing the zoom zone and the parameters of the measurement on display (signature of the measurement).
– the main part of the screen, displaying a menu or the page of results.
– tabs enabling the user to switch from one function to another (OTDR, WDM, power meter, etc.), as required.

At the right-hand side of the screen, softkeys give access to the various commands. Their action depends on the current function and configuration.

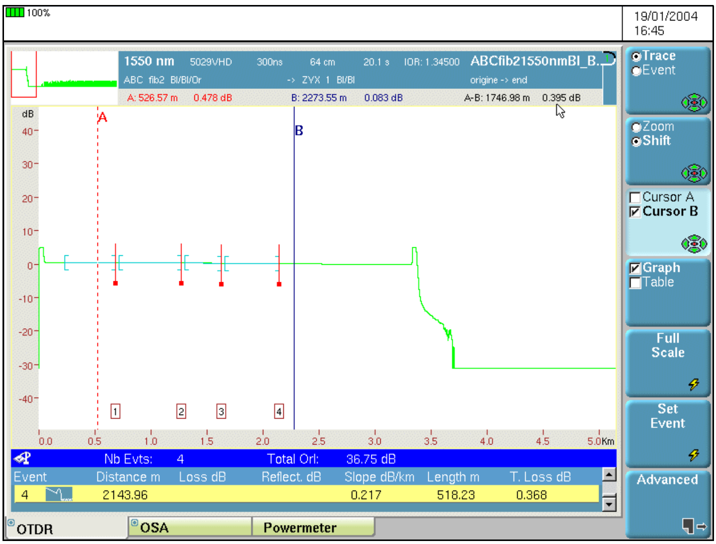


Fig. 13 Example of display of results (with OTDR plug-in)

Top status bar

The top status bar on the screen shows, on the right, current date and time, and in the form of icons:

– the type of power supply: mains or battery, and if the power supply is on battery the level of charge (see Battery management in chapter 2 from the Base Unit base manual)
– if saving is in progress, the icon .
– if the Talkset option is present and the telephone is activated, the icon .
– if a remote screen is selected, the icon
– if transfer of data is in progress, the icon .

Mini-trace

The **File** menu and the **Results** page can include a scaled-down representation of the trace which may show the location of the zoom zone corresponding to the main display. The part of the trace shown in the main display is boxed on the mini-trace.

This mini-trace will only appear if the trace originated from an Base Unit. Other Bellcore files read on this instrument do not contain the information needed to display it.

Signature of the measurement

A status bar repeats the parameters of the measurement, and in some cases:

– the position of the cursors
– a comment
– the name of the file when the result is recalled from a memory.

Main display zone

The central zone of the screen can display the configuration of the instrument or the measurement, the memory explorer of the Base Unit, the measurement results, etc. Refer to the chapter dealing with the measurement in progress.

Tabs

When the instrument performs several different functions (OTDR, WDM, Power Meter, etc.), the various configuration or results pages are accessible from tabs. To change from one tab to another, the button selecting the page must be pressed. To example:

– on the Results page, to change from one tab to the other, press the **RESULTS** button

– on the measurement configuration page, to change from one tab to the other, press the **SETUP** button
– On the file configuration page, to change from one tab to the other, press the **FILE** button.

> **NOTE**
>
> There is a tab for each different type of measurement: OTDR SM, OTDR MM, OSA, Power Meter. The tab of a function is displayed if and only if a plug-in corresponding to this type of measurement has been inserted in the instrument, or if a file of the type of this measurement is open. If two plug-ins of the same measurement type are present, then only one plug-in is "active", so only one tab will appear for this measurement. To change the active plug-in, go to the SYSTEM screen and select it there.

A small icon may appear in the left corner of each tab, according to the status of the corresponding module.

The icon signification is the following :

– No icon : the function is used in a read-only mode (no module), or the module has not been selected.
– Gray icon : the function has been selected but the corresponding module does not currently perform an acquisition.
– Green icon : the function has been selected and the corresponding module currently performs an acquisition.

Soft keys

The 7 softkeys at the side depend on the current configuration and the context.

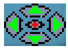
Their use is symbolized by an icon.

Icons

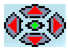
shows that the action is immediate when the key is pressed.

shows that the key gives access to a sub-menu.

shows that the key will quit the sub-menu.



(green direction keys) shows that the function selected by the key will be controlled by the direction keys.

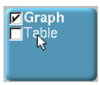


(green confirmation key) shows that the function selected will be controlled by the confirmation key.

Selection keys

The selection may be exclusive (only one choice possible) or non-exclusive (more than one option available at the same time):

This key offers two exclusive options. The change of function occurs immediately, the first time the key is pressed.



This key offers two non-exclusive options. Pressing the key repeatedly modifies the choice.

Color of the keys

When a selection key is associated with direction keys or the confirmation key:

- if the function is not selected, the key is dark blue.
- pressing the key once selects the function. The key turns lighter in color to show the user that the direction keys are assigned to it. Pressing more times will modify the choice made using the key.

Using an external keyboard, mouse and screen touch (options)

The external keyboard facilitates input of:

- alphanumerical configuration parameters
- comments in the File menu
- notes in the table of results
- editing characters

The mouse can be used instead of the direction keys to scroll through menus and make a selection.

Connect the keyboard and mouse to the USB connectors.

Virtual control buttons bar

It is possible to emulate hard keys with Virtual Control buttons

To display these buttons, click once on the top of the screen in the status bar, at the same height than the date and time.

Fig. 14 Virtual control buttons bar

The virtual control buttons bar is displayed during a few seconds. You may click on any of these buttons to obtain exactly the same results than using the real buttons in the front panel of the Base Unit.

> The virtual control buttons bar can not be displayed within desktop applications (see the User Manual of the Base Unit).

> **NOTE**
>
> This virtual control buttons bar is especially useful when the Base Unit screen is exported on a remote PC (see the User Manual of the Base Unit).

Equivalence between external keyboard and Base Unit

Although it is intended primarily to replace the Edit menu of the Base Unit, the external keyboard can replace all the buttons and keys of the Base Unit except the **ON/OFF** button**:**

- The menu keys to the right of the screen are replaced by the function keys **F1** to **F7**.
- The buttons below the screen are equivalent to **Ctrl +** a letter (see table below).
- The direction keys have the same function on the external keyboard and on the Base Unit.

Function on the Base Unit	External keyboard
SYSTEM	Ctrl + Y
SET-UP	Ctrl + U
PRINT	Ctrl + P
FILE	Ctrl + F
RESULTS	Ctrl + R
START/STOP	Ctrl + S
SCRIPT (Macro)	Ctrl + M
◀ ▲ ▶ ▼	← ↑ → ↓
Menu keys 1 to 7 (from top to bottom)	F1 → F7
SAVE AND QUIT (EXIT)	Entrée/Enter
QUIT WITHOUT SAVING (ABORT**)**	Escape/Echap.

Editing text using the external keyboard

To use the external keyboard to insert a name or identification in the set-up menus, or a Note in the table of results:

– press **Enter** to go into the Edit menu
– type the text
– press **Enter** to leave the Edit menu.

Pressing the **Esc** key will close the Edit menu without saving the text.

Functions relating to display of a trace

The trace acquired or recalled from a memory is displayed on the Results page: see example on Figure 13 on page 30.

Various functions common to many plug-ins (OTDR, OSA etc.) can be used to modify the display of the trace (Cursors, Zoom/Shift, Event/Trace, Trace/Table, Full scale, etc.). The role of the direction keys and the confirmation key will depend on the function chosen.

Display of the results on the trace

Each event (OTDR measurement) or channel (WDM measurement) detected is represented under the trace by a serial number.

The results of the measurements can be written on the trace.

Depending on the options chosen in the **SETUP** menu on **Result Screen > Results On Trace**, it is possible to show on the trace, for an OTDR measurement:

- "No" results,
- or "All" the results (value and position)
- or only the markers showing the position of the events measured

When there is saturation for a reflective event (OTDR measurement), the maximum value measured is displayed with the sign >. This shows that the actual reflectance is greater than the value shown (for example, if R >-29.5 dB is displayed, the reflectance could be -18 dB)

The reflectance of a ghost event (OTDR measurement) is displayed in brackets on the trace.

Cursors

The vertical cursors A and B are used in the Zoom and Shift functions to position or delete markers.

The cursors A and B are represented by vertical lines of different colors:

- in a solid line if the cursor is selected.
- in a dotted line if the cursor is not selected.

Positioning the cursor

When a trace is displayed, the key <Cursor A/Cursor B> can be used to select one or both cursors.

The direction keys ◀ and ▶ move the selected cursor(s) along the trace.

Above the trace are shown the co-ordinates of the points of intersection of the cursors A and B with the trace, together with the distance between the two points.

When a selected cursor touches the right or left-hand edge of the screen, the trace starts to scroll horizontally to maintain display of this cursor.

If an unselected cursor has been moved off-screen by a zoom, it can be brought back on to the screen by selecting it and then pressing one of the direction keys ◀ or ▶. It will then appear on whichever edge of the screen is closest to its position.

When the cursor function is selected, the keys ▲ and ▼ move the trace vertically.

Selection of the type of cursor

Two types of cursors can be defined:

1 Cursor on X: only a vertical bar is present.

2 Cursor on X and Y: there is a vertical bar and a horizontal bar. The intersection between these two bars is placed on the trace.

To display the type of cursor selected, click on **Advanced**. Then select the key **CursorX/CursorY** to modify the current choice. Each click on this key will alternatively insert or delete the check mark against **Cursor Y**.

Zoom and Shift functions

Zoom function

The Zoom function is used to analyze part of the trace in greater detail. In association with Event (OTDR) or Channel (WDM) it enables rapid checking of a succession of events or channels.

<u>The zoom is centred on the cursor selected</u>. If the two cursors A and B are selected, the zoom is centred midway between the two cursors.

The position of the section of trace displayed with respect to the complete trace is represented by a red rectangle on the mini-trace at the top left-hand corner of the screen.

To define a zoom on the trace:

– select cursor A or B and center it on the zone to be examined
– on the **Shift/Zoom** key, select the **Zoom** function.
– use the ▶ or ◀ key to increase or reduce the zoom factor.

Zooming on the different events in succession (OTDR measurement)

– Zoom on one of the events detected as shown above.
– On the **Trace/Event** key, select the **Event** function
– Use the ◀ and ▶-keys to move the zoom on to the successive events.

Zooming on the different channels in succession (OSA measurement)

– Zoom on one of the channels as shown above.
– On the **Trace/Channel** key, select the **Channel** function

Use the ◀ and ▶-keys to move the zoom on to the successive channels.

Shift function

The Shift function is used to displace the displayed section of the trace by pressing the direction keys.

The horizontal shift is performed maintaining the point of intersection between the trace and the selected cursor at the same level, scrolling the trace horizontally while following it vertically, so that it never goes off the screen.

To use this function:

– Select the zoom factor as described above.
– Choose cursor and cursor position.
– On the **Zoom/Shift** key, select **Shift**.
– Use the direction keys to shift the trace in the desired direction.

NOTE

For a Chromatic Dispersion curve, click on **Config** in order to display the zoom and shift functions.

Zoom Auto (OTDR)

The **Zoom Auto** key allows to go to an optimized display of the trace.

Full scale (OSA / PMD / AP)

To display the entire trace, with no zoom or displacement:

– either press the **Full Scale** key

– or, with **Trace** selected on the **Trace/Event** key, press the  button.

Overlay trace function

This very useful function enables up to eight traces to be displayed on the screen at once:

– either to compare traces acquired on a number of different fibers in the same cable,

– or to observe changes over time in traces taken of one and the same fiber.

– or to compare both curves get for each way of propagation in the o/Back mode.

For this purpose, the Base Unit possesses an overlay memory which can store:

– the current trace, for comparison with further traces to be acquired subsequently,

– or reference traces previously saved on floppy disk or CD-ROM or in the internal memory, for comparison with the current trace,

– or traces of different wavelengths for comparative purposes (OTDR).

Fig. 15 Example of overlaid traces

Overlaying several traces stored in memory

To display up to 8 traces from the memory, deleting the current trace or traces already loaded:

1. Press the **FILE** button**.**
2. On the **Menu/Explorer** key, select **Explorer**.
3. Select the files of the traces for display (see "Multiple selection of files" page 236).
4. Press the **Load key**.
5. Press <View traces> or **Load traces + config**: as the traces are loaded, they cease to be highlighted in the list of files.
6. When loading is complete, the **Results** screen appears: the first trace selected is the active trace, the other traces being overlaid.

Display of traces in overlay

– The traces are shown in different colors (the active trace is green).
– Their serial numbers are repeated at the top of the screen.
– The OTDR markers are referenced on the active trace by the symbol , and on the other traces by vertical dashes.

Adding traces in overlay

With one or more traces already displayed, to add further traces to the display (the number of traces displayed cannot exceed 8):

- Press the **FILE** button, and in the Explorer menu, select the files of the traces to be added (see "Multiple selection of files" page 236).
- Press the **Load** key
- Press the **Add Traces** key: as the traces are loaded, they cease to be highlighted in the list of files.
- When loading is complete, the new traces are displayed in overlay with those that were already there.

> **NOTE**
>
> If the number of files selected exceeds the display capacity, a message gives warning that loading will be incomplete: only the trace or traces selected first will be displayed, up to the permitted limit of 8 traces.

Overlaying the current trace

To copy the current trace into the overlay memory, proceed as follows:

- On the **RESULTS** page, press the **Advanced** key, then **Overlay**, then **Set Overlay**.

  The current trace is copied into the overlay memory: represented in a different color, it is automatically offset with respect to the new trace.
- A new acquisition can then be started.

> **NOTE**
>
> In the case of Multi-trace display with multiple wavelength acquisition: when the **START** key is pressed, all the traces displayed are deleted to leave room for the new acquisitions.

Swapping overlay traces

Measurements can only be made on the active trace and not on overlaid traces. To make measurements on a trace in overlay, it must first be swapped with the active trace. To do this, press the **Trace** key, then the ◀ and ▶ keys, as many times as necessary.

Trace resulting from the difference between two traces (OSA module)

It is possible to obtain the trace corresponding to the point-by-point difference between the current trace and the trace in overlay (if only two traces are displayed simultaneously).

To do this, press the **2 Traces Diff.** key. The screen will then display the two traces in overlay and the trace resulting from the "Difference".

Removing a trace

Removing a trace in overlay

It is possible to remove a trace displayed. To do this, first activate it (see previous paragraph), then press **Remove Trace**.

Removing all the the traces in overlay

To remove all the traces except the current trace, press the key **Remove Traces**.

Quitting the overlay menu

To quit the overlay menu, press the **Exit** key.

Saving when the instrument is shut down

When the instrument is switched off, all the parameters and all the traces are saved, and will all be recalled at the next start-up.

Reflectometry measurements

4

Pressing the **START/STOP** key is all that is needed to start or stop a measurement. However, it is necessary to configure the measurement and the type of results desired.

This chapter describes the different stages in a reflectometry measurement made using an OTDR plug-in and the OTDR function of a 5083CD plug-in.

The topics discussed in this chapter are as follows:

Selecting the function

Press the **SYSTEM** button. If the instrument is equipped with several plug-ins or if the sole module performs several functions:

– use the direction keys ◀ and ▶ to select the function: the icon under the mouse pointer is surrounded with a green frame.

– select the function by pressing ↵ : the icon turns orangy-yellow.

Configuring the reflectometry test[1]

To call up the test configuration window, press the **SETUP** button.

Dialog boxes on one and the same screen enable selection of measurement parameters, and display of results and fiber parameters.

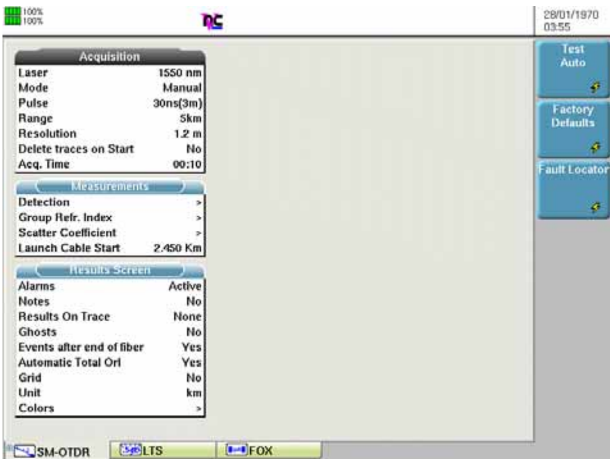


Fig. 16 OTDR SETUP screen (with dual-wavelength module)

In these windows, the parameter selected is in video inverse. Select this parameter by means of the direction keys ▼ and ▲.

1.if an OTDR module is installed

The available choices then appear on the screen; they depend on the function selected. Make the choice by means of the direction keys ◀ ▶.

Acquisition parameters

You can choose the following acquisition parameters, whatever the type of measurement displayed on the trace.

> Those measurement parameters are only linked to the next acquisition.

If the acquisition parameters are not accessible, check that the OTDR function has really been selected (see "Selecting the function" on page 44).

– **Laser** The acquisition will be carried out on the wavelength selected (for multiple-wavelength modules): the possible values depend on the modules.
All: the acquisition will be carried out on all available wavelengths.

– **Mode** Choose the mode of detection of events:

- Real time: the Base Unit performs up to ten acquisitions per second and displays the resulting trace in real time together with an indicator of the state of the connection. This mode makes it possible to analyze a fiber quickly without any memory effect, and thus to check the establishment and quality of the connections.
- Manual: the acquisition parameters must then be configured as a function of the fiber to be tested. When acquisition is complete, a measurement is made and the results are displayed.
- Auto: the Base Unit starts an acquisition with an automatic configuration making the best compromise for Pulse/Range/Resolution. When acquisition is complete, a measurement is made and the results are displayed.
- Fault Locator:the Fault locator mode allows to detect the end of fiber distance from the origin and, by consequence, to detect a possible break of this fibre (see "Fault Locator Mode" on page 72).

- Source (for CD modules and VLR modules)

  The Source mode allows to activate the wavelength previously defined. Pushing the **START** button activates the source in the CW mode.

– **Pulse** This depends on the type of OTDR module. See "Typical specifications of OTDR plug-ins" on page 255.

– **Range** This depends on the type of OTDR module. The possible range depends on the pulse length selected. This range is given for each pulse length in the paragraph "Ranges" on page 257. In Auto mode, the range is selected as a function of the end of the fiber.

– **Resolution** From 4 cm to 160 m according to module.
No calibration of the measurement. The choice offered depends on the range and pulse selected.
In Auto mode, resolution is selected automatically according to
the last two parameters above.

– **Delete Traces on Star**t
Yes: as soon as the next acquisition is initiated with the **START** key, the traces previously acquired are deleted.
No: as soon as the next acquisition is initiated with the **START** key, the the traces previously acquired are saved.

For a multi-wavelength acquisition, this parameter is automatically set to Yes.

– **Acquisition time** From 5 s. to 10 minutes max.

Test Auto

The **Test Auto** key imposes the following parameters:

– Acquisition parameters:

  Laser: All

  Mode: Auto

– Saving parameters (see chapter "File management"):

  File naming:
  [cable] [fiber name] [wavelength] [pulse] [direction]

  Increment Fiber number: Yes

  Auto Store: yes

Factory default settings

The **Factory Defaults** key imposes the parameters for acquisition, measurement and display of results defined as default settings in the factory.

Measurement parameters

You can select the following measurement parameters, in the **Measurements** field.

> Those parameters are valid for all traces present on the screen.

Detection

Choice of events to be detected:

– Splices:

  All: all splices will be detected
  None: no splice will be detected
  or choose the threshold from which splices will be detected between 0.01 dB and 1.99 dB in steps of 0.01 dB.
  Factory default value: All.

– Reflections:

  All: all reflections will be detected
  None: no reflection will be detected
  or choose the threshold from which reflections will be detected between -99 and -11 in steps of 1 dB.
  Factory default value: All.

> **NOTE**
>
> If no result is displayed after a measurement, make sure that the parameter **All** is selected for the detection of splices and reflections.

– Fiber end

  – **Auto** (recommended) option in which the Base Unit automatically detects the end of a fiber.

  – 3 to 20 dB (in steps of 1 dB): threshold of detection of end of fiber.

  Factory default value: Auto.

– **Bend**: Select the bend value (in dB), using the direction keys ◀ and ▶ or the numeric keypad.

– **Macro Bend Wavelength**: select the wavelength for the macro bend: No / 1310/1550nm / 1310/1625nm / 1550/1625nm.

Refraction index

Choice of group refraction index of the whole fiber.

- User
  - Either: define for each wavelength (1310 SM, 1360-1510 SM, 1550 SM, 1625 SM) a refraction index of 1.30000 à 1.69999. The selection of an index alters the value of the section AB (actual distance between cursors A and B).
  - or, if the actual distance between the cursors A and B is known, enter its value under Section AB to establish the index of the fiber. Selection of this distance causes the display of the indices. The extreme distance values are given by the index values (1.30000 à 1.70000).
- Predefined index
  - It is possible to choose one of the predefined values given for certain cables. The corresponding indices given in the table below are repeated on the screen.

Wavelength (nm)	**1310 SM**	**1475 1480 1510 1550 1625 SM**
ATT SM	1.46600	1.46700
Corning SMF-28	1.46750	1.46810
Corning SMF-DS	1.47180	1.47110
Corning SMF-LS	1.47100	1.47000
Corning-LEAF	1.46890	1.46840
Fitel Furukawa	1.47000	1.47000
Lucent Truewave	1.47380	1.47320
SpecTran SM	1.46750	1.46810
Litespec	1.46600	1.46700

Fig. 17 Predefined index values (Single Mode)

Wavelength (nm)	**850 MM**	**1300 MM**
Corning 62.5	1.50140	1.49660
Corning 50	1.48970	1.48560
SpecTran 62.5	1.49600	1.49100

Fig. 18 Predefined index values (Multi Mode)

Backscatter coefficient

- User — Selects for each wavelength, the backscatter coefficient of -99 dB to -50 dB by increments of 0.1dB. Modification of the backscatter coefficient K changes the measurements of reflectance and ORL.
- Auto — Backscatter coefficients are selected automatically for each wavelength.

The default values are given in the paragraph "Reflectance" on page 3.

Launch cable at start

- No — All the results are displayed and referenced on the basis of the board of the plug-in.
- Evt 1, 2, 3 — The results relating to the launch cable are eliminated from the table. Attenuation and distances are then measured on the basis of the marker Evt 1, 2 or 3 selected.
- Distance — Use the **Edit Number** key to enter a distance (Min= 0 / Max=10 km / 32.81 kfeet / 6.22 miles)

  or

  Affect the active cursor value, using the **Active Cursor Value**

Factory default value: None.

Result screen

Those parameters are valid for all the traces present on the screen.

- **Alarm**

  No: the alarm function is not active.

  Active: results lying outside the thresholds selected by the user in the Alarm field (Max splice, Max Connector, etc.), will be displayed in red in the table, and the icon will appear at the top right of the screen. If all the results lie within the thresholds (no result is in red), the icon becomes .
- **Notes** — See "Table notes" on page 62

No: no display of notes

Notes: display of notes entered by the user

Uncertainties: display of indicators of the level of confidence in the measurement result.

Factory default value: No.

– **Results on trace Displays**:

No: the trace alone.

All: the trace with results and markers.

Graphics only: the trace with markers only.

Factory default value: All.

If «All» or «Graphics only» is selected, the reflectometry trace is displayed with a dotted vertical line set on the end of launch cable (if the Launch Cable is defined in the **SETUP** menu) and a dotted vertical line on the end of fiber .

– **Ghosts** Choice (Yes or No) of whether information relating to ghosts is to be displayed. If ghosts are displayed, the reflection icon in the table of results appears dotted and the reflection value is displayed in brackets on the trace, for example «(R:-50 dB)».
Factory default value: Yes.

NOTE

Ghosts are detected only during an automatic measurement.

– **Events after end of fiber** if yes, the events after the end of fiber are detected.

Factory default value: Yes

– **Measure ORL** if Yes: results of the total ORL measurement are displayed
Factory default value: Yes.

– **Grid** if Yes, the grid is present on the result screen
Factory default value: No.

– **Unit** Units of the distances displayed: km, kfeet, miles.

– **Color (RVB)** When overlaying several traces (see "Overlay trace function" on page 39), you can change each trace color.

- Active curve: allows to change the active curve color

. - Curve 1 to 8: allows to change the selected curve color (from trace 1 to 8)

> **NOTE**
>
> To get the default color for each trace, select the trace number and click on **Factory Color**.
>
> When you change the trace color, the new color is displayed at the right side of its value.

To obtain the configuration selected in the factory, press the F**actory Defaults** key.

Acquisition

There are 3 ways to start an OTDR acquisition with the Base Unit:

– a real time mode, in which the Base Unit makes acquisitions up to ten times per second and displays the resulting trace, together with an indication of the state of the connection in real time.

– an automatic mode, which enables quick starting of an acquisition followed by automatic measurement.

– a manual mode, in which the acquisition parameters can be configured as a function of the fiber to be tested. The acquisition is followed by automatic measurement.

The mode of acquisition is selected after pressing the **SETUP** button, on the **Acquisition > Mode** line (see "Acquisition parameters" on page 45).

In the case of the multiple-wavelength modules, the acquisition will be started on the different wavelengths successively if the option All is selected on the **Acquisition > Laser** line.

Battery saver

When running on battery, if no acquisition has been performed for two minutes, the power supply of the module is cut off to save the battery.

> **NOTE**
>
> Traffic on the fiber under test is automatically detected and reported. If the fiber connected to the OTDR module is active, a message indicating a signal in the fiber under test is displayed. You can therefore choose to continue the measurement or to stop it and to restart the measurement once the fiber is disconnected.

Real time mode

Acquisition in real time must not be used if a precise measurement is required because of the high noise level, but it is sufficient for rapid optimization of a connection and for observing a fiber in process of utilization.

To carry out an acquisition in real time, after selection of the requisite acquisition parameters (see "Acquisition parameters" on page 45):

- either, if **Auto** or **Manual** mode is selected in the **SETUP** menu, hold the **START** key down for about two seconds, when the acquisition in real time will begin
- or choose the Real time mode of acquisition in the **SETUP** menu, then press the **START/STOP** key.

The red **Testing** indicator will go on to show that real time acquisition is in progress. The trace acquired is displayed in real time. An indicator of the state of the connection (**Good/Bad**) is displayed below the trace.

> **NOTE**
> If the connection is bad, check and clean the connector or the jumpers.

To terminate or interrupt an acquisition in real time mode, press the **START/STOP** key.

Connection quality indicator

The connection quality indicator gives the following information:

State	Connection
Good	The connection is OK
Bad	Possible causes of a bad result: – There are several connectors close to the external connector of the Base Unit. – One of the connectors is dirty or badly connected. Replace the launch cable, make the connection again properly or clean the connector of the OTDR or of the jumper. – No fiber is connected.

If the state of the connection is bad, it is still possible to carry out a measurement, but the results will not be very reliable.

Real time display

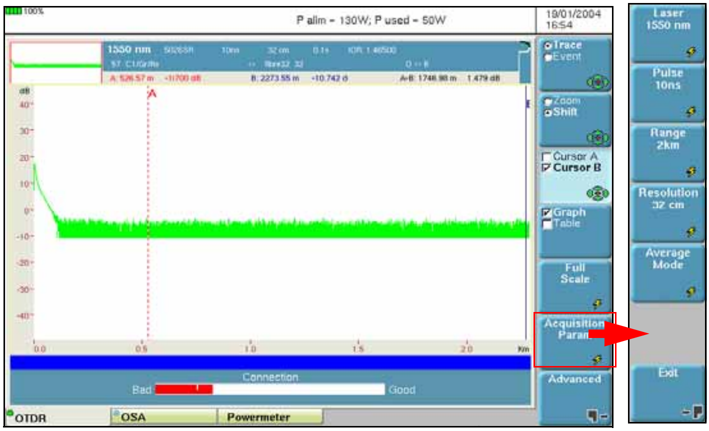


Fig. 19 Example of acquisition in real time

During an acquisition in real time, you can modify the acquisition parameters without returning to the **SETUP** menu. To do this, press the **Acquisition Param** key: you can then use display keys to scroll through the possible values of the various acquisition parameters.

In real time mode, only measurements relating to the cursors are possible, but as soon as acquisition stops, automatic measurement is possible.

Automatic acquisition mode

The fastest way of detecting faults in your optical fiber is to use automatic acquisition mode. The Base Unit then uses the acquisition parameters (pulse width, range and resolution, and acquisition time best suited to the fiber to be tested).

> **NOTE**
>
> In Auto mode, since all the parameters have been reconfigured, overlay and marker locking are not possible during acquisition.

Automatic configuration of acquisition

Press the **SETUP** button, then:

1 either choose the configuration manually:
on the **Laser** line, select the wavelength of the laser (if the Base Unit uses a dual-wavelength plug-in),
on the **Mode** line, select **Auto**,

2 or select **Test Auto** or **Factory Defaults**

Acquisition phases in automatic mode

When the **START/STOP** key is pressed, an automatic configuration procedure selects the optimum parameters, after which acquisition is carried out in three phases:

– Phase 1: Choice of the best range to display the whole of the fiber under
test.
– Phase 2: Choice of the ideal pulse width and of the acquisition time to qualify the fiber accurately; for example the one that gives the best resolution for a given dynamic.
– Phase 3: Display of the quality of the connection (see "Connection quality indicator" on page 52)
– Phase 4: The elapsed averaging time and the number of averages calculated are displayed. When the duration of acquisition has elapsed, the automatic measurement is carried out.

NOTE

The acquisition can be stopped at any moment by pressing the **START/STOP** key. Then an automatic measurement is performed, but certain events cannot be detected: a manual measurement must then be made.

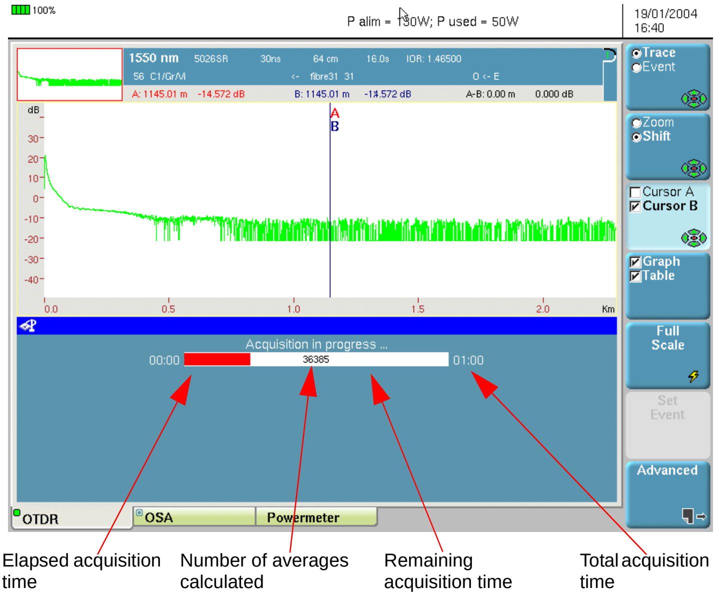


Fig. 20 Example of automatic acquisition

A the end of Auto acquisition, the parameters are automatically updated in the Acquisition menu.

> Auto acquisition mode deactivates the **Set Event** function (see "Memorization of the position of events" on page 71): the measurement is then re-initialized.

Manual acquisition mode

In this mode, the Base Unit carries out a number of averagings defined as a function of the maximum acquisition time specified in the Acquisition menu, and then terminates the acquisition. The acquisition is carried out with the parameters previously selected in the **Acquisition** menu. It may be stopped at any time using the **START/STOP** key.

To configure a manual acquisition of the fiber under test, follow the procedure described below, in the **SETUP** menu (see "Acquisition parameters" on page 45):

1 Select the wavelength on the **Laser** line.

2 On the **Mode** line, select **Manual**.

3 On the **Pulse** line, select the required pulse length from the values proposed.

4 Select the required **Range** from the values proposed.

5 Select the **Resolution**.

6 On the **Acquisition Time** line, select the duration of acquisition.

7 Press the **START/STOP** key to start the acquisition.

The red indicator goes on to show that the Base Unit is in process of acquisition and the screen displays the trace in process of acquisition. The quality of the connection is displayed for a few seconds, then a bar graph shows elapsed and remaining acquisition time.

8 A the end of the acquisition, the trace is displayed and an automatic measurement is started.

NOTE

To stop the acquisition, the **START/STOP** key may be pressed at any time. Then an automatic measurement is carried out, but certain events cannot be detected (a manual measurement must then be carried out right to the end).

Multi-wavelength acquisition

If the plug-in possesses several lasers, to perform successive acquisitions on all the wavelengths:

– in the **SETUP** menu, on the Laser line, choose **All**.

– start the acquisition (manual or automatic) by pressing the **START** button.

The different traces appear in the same window and can be handled similarly to overlaid traces (see "Swapping overlay traces" on page 41).

Trace display functions

The trace acquired or recalled from a memory is displayed on the Results page: see example Figure 13 on page 30.

A number of different functions can modify the display of the trace (Cursors, Zoom/Shift, Trace/Event, Graph/Table, Full Scale, etc.). See page 35.

See "Overlaying several traces stored in memory" on page 40 for overlay of traces.

The reflectometry trace is displayed with a dotted vertical line set on the end of launch cable  (if the Launch Cable is defined in the **SETUP** menu) and a dotted vertical line on the end of fiber  .

Displaying results on the trace

Each event detected is referenced under the trace by a serial number.

The results of the measurements of attenuation, reflectance and slope can be marked on the trace.

Depending on the choice made in the **SETUP** menu, on **Result Screen > Results on Trace**, it is possible to show on the trace:

– "No" results,
– "All" results (value and position)
– or only the markers showing the position of the events measured

When there is saturation for a reflective event, the maximum value measured is displayed with the sign **>**. This shows that the actual reflectance is greater than the value shown (for example, if R >-29,5 dB is displayed, the reflectance could be -18 dB)

The reflectance of a ghost event is displayed in brackets on the trace.

Events

NOTE

To display all the events, make sure that the detection thresholds (Splice and Reflection) are positioned on **All** in the **SETUP** menu **>Detection**.
To display the results on the trace, make sure that the option selected in **Results on Trace** is **All** in the menu **SETUP**.

Trace/Event functions

1 The **Trace** function is useful in a multi-trace display, as the direction keys can then be used to select the active trace, which turns green.

2 The **Event** function of the Base Unit enables the cursor to be moved on to the faults that have been measured and the results of which are displayed on the screen.

After selecting the **Event** function on the **Trace/Event** key, pressing the keys ▲, ▼, ◀ or ▶ once will move the cursor from one event to the next. This function, in association with **Zoom** and **Cursor**, enables rapid analysis of the fiber.

> **NOTE**
>
> While moving from one event to another, the value of the zoom is conserved (unless this is impossible).

Criteria for display of an event

An event will be displayed if its attenuation or its reflectance exceeds the corresponding threshold selected in the **SETUP** menu (see "Acquisition parameters" on page 45). Both results for an event will be displayed if they can be calculated. The following table gives some examples of detection of events for different threshold values.

E.g.	Value of the thresholds		The Base Unit displays a value if the attenuation <u>or</u> the reflectance has one of the following values	
	Attenuat. (dB)	**Reflect. (dB)**	**Attenuation**	**Reflectance**
1	0.05	- 60	≥ 0.05 dB	> - 60 dB[1]
2	1	- 15	≥ 1 dB	≥- 15 dB[2]
3	6	---	≥ 6 dB	

1. *Example: a value will be displayed at -43 dB.*
2. *Example: a value will be displayed at -14 dB but not at -20 dB.*

The reflectance of an event is always measured except when the event causes a saturated Fresnel peak or if it is drowned out by noise. In this case, the Base Unit displays **>** to show that the actual reflectance exceeds the value displayed.

For example, to detect all the splices on a fiber having attenuation greater than 0.05 dB, select the different thresholds of the events to be detected in the menu called by the **SETUP** key, in the **Measurements > Detection** window. Relative measurements, using the two point method,

can be carried out by means of the Event function in coordination with the two cursors. For example, you can analyze the total loss on a link with launch cable. To do this:

1 Place one of the cursors at the end of the launch cable.

2 Select the other cursor.

3 Use the Event function. The measurements displayed give the actual distance from the start of the link and the attenuation of the link plus the attenuation of the connection.

Table of results

NOTE

To display all the events, make sure that the detection threshold selection in the **SETUP** menu is **All**.

Two types of tables of results are possible with the Base Unit:

– A table with a line displayed under the trace and giving the type and characteristics of the event nearest to the cursor.
– A table giving the type and the characteristics of all the events detected during the automatic measurements: the 8 lines displayed correspond to the 8 events nearest to the cursor. The line corresponding to the event nearest to the cursor is highlighted. This highlighting moves if the cursor is moved.

At the top of the table, a line shows the generic parameters of the fiber: numbers of events present, total ORL of the link, marker locking icon and launch cable length (if selected).

Change of table

To obtain the 8-line table, select the Table function on the **Graph/Table/Bend** key. To return to display of a single line in the table, select the Graph function. To display the table and the trace dedicated to the bend, select the Bend function.

In Bend mode, there is neither access to the events function nor to the expert mode because the Bend function analyzes two traces at the same time. Go back to the Table or Graph function to have access to these functions.

To scroll through the table, if it contains more than 8 lines:

– either select the **Cursors** function, and move the selected cursor along the trace using the keys ◀ and ▶

– or select the **Event** function, and move the cursor through the table, using the keys ▲ and ▼.

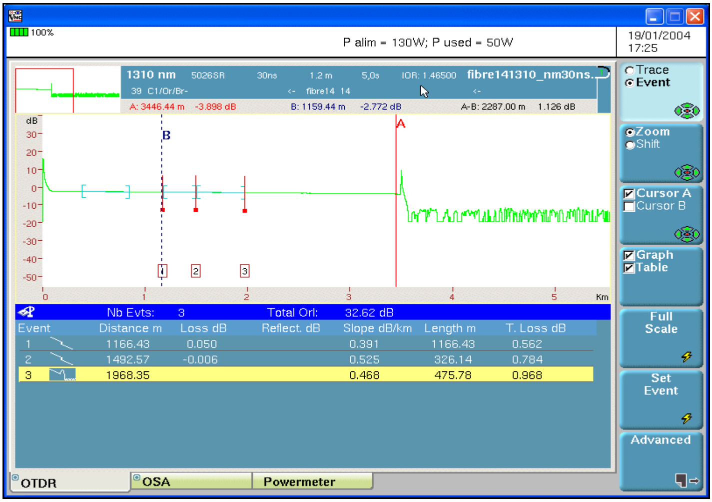
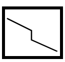


Fig. 21 Example of table of results

Information provided for each event detected

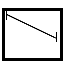
Each event is referenced under the trace by a serial number which is repeated in the first column of the table. The table then shows:

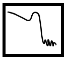
– an icon symbolizing the type of the event:


Non-reflecting attenuation (e.g. splice).

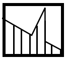

Event with reflection (e.g. connector).


Ghost reflection.

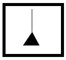

Slope of the fiber (when no fault follows the slope).



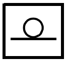
End of fiber



ORL measurement



Event marker when a measurement cannot be carried out. If the event to be added is too close to an existing event, the icon appears on the trace and the table, but no measurement is carried out: to obtain the results for this event, a manual measurement is necessary.



End of launch cable: the attenuation and distances are measured on the basis of the corresponding marker.

– The distance of the event from the beginning of the fiber, in metres (or kfeet or miles).
– The attenuation due to the event, in dB.
– The reflectance of the event, in dB (or the ORL result if an ORL measurement has been carried out).
– The slope before the event, in dB/km (dB/kft) if it can be measured.
– The length of the section, that is to say the distance between the marker of the event and the previous marker.
– The total attenuation of the fiber (total dB loss), in dB.

The table of results is interactive, and reflects the measurements in progress. Any operation carried out on the trace is immediately entered in the table, so that you can see the result.

Modifying types of events

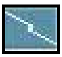
The types of events are detected automatically as a function of their optical signature. This can sometimes lead the system astray, if reflection from a connector is too strong (end of fiber?), if a splice has a very low insertion loss (slope?), etc. Similarly, some types of events cannot be recognized automatically from their signatures (for example, couplers, multiplexers, etc.). For this reason, it is advantageous in some cases to be able to change the type of events.

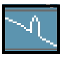
To do this:

– In the **Advanced** menu select **Manual measurement**
– Select the **Evt Code** button.

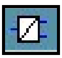
Fig. 22 Buttons used to modify types of events

New, more specific event types are then proposed:

 Splice

 Connector

 Mux/Demultiplexer

 Separator/Coupler

 End of fiber

 Ghost

– Position the cursor on the line for which modification of event type is desired.

– Click on the button corresponding to the required type of event.

Table notes

With each event, it is possible to associate:

– a note of no more than 40 characters, entered by the user

– an indicator of uncertainty qualifying the result displayed.

> **NOTE**
>
> This information appears in the table, under the line relating to the event, if it has been validated in the **SETUP** menu on the **Notes** line.

Notes

For each wavelength, a maximum of 16 notes is possible.

For each note, 40 characters can be entered.

> **NOTE**
>
> Each note is associated with an event. Consequently, if the event is deleted, the note the will be deleted too.

To enter a note:

– in the menu: **SETUP > Result Screens > Notes**, the Notes option must be selected

– on the **Results** page, in the table, select the event

– press **Advanced**

– press **Notes**

– enter the text of the note in the edit menu that appears

– press **Confirm** and then **Exit**.

In the table of results, the user can display indicators to evaluate the uncertainty of the result. This function must be validated in the **SETUP** menu, on the **Notes** line.

The notes are displayed under the selected event, in the results table.

Uncertainty of results

The following cases are possible:

Indicators concerning attenuation measurements	
2c manual	Result of a manual measurement between the reference and the cursor using the 2-cursors method.
5c manual	Result of a manual measurement using the 5-cursors method.
Global	The attenuation displayed is a global result for Fresnel reflections which are not sufficiently separated.

Close evts	As several events are too close together, only the attenuation of the last one is displayed.
Indicators concerning measurements of slope	
Few pts	Measurement of slope by the least square approximation method without using many points of acquisition.
2 points	Measurement of slope by the 2-point method.

> **NOTE**
>
> The **SETUP** menu, **Notes** line, enables display of notes, of uncertainties or of neither the one nor the other. Notes cannot be displayed at the same time as uncertainties.

Automatic measurement and detection

Automatic mode enables rapid detection of all the faults in the trace. The faults detected are then measured and identified on the screen by markers. Only the results exceeding the detection threshold defined in the **SETUP** menu are displayed.

> **NOTE**
>
> Before starting an automatic measurement, make sure that the function **Lock Evts** (accessible by pressing **Advanced**), is not activated (the icon  must not be present in the left-hand corner under the trace).

By means of this method of detection, you can quickly locate all the faults in the fiber under test.

If an automatic measurement does not detect all the events, additional manual measurements can be carried out.

To delete all the markers, press the **Advanced** key, then select **Del Res.**.

When there have not been any measurements, to carry out an automatic measurement, press **Advanced** then select the function **Auto Mes.**.

The following procedure is recommended:

1 Fully automatic measurement: the instrument locates the events and proceeds to the measurements.

2. Addition of markers (see “Addition of markers” on page 65) in the cases of splices showing low attenuation and of close events. The Base Unit then automatically measures the slope before and after the markers selected and measures the attenuation of the splice.
3. Addition of manual measurements if necessary (in the case of very close events). The Base Unit performs the measurements requested by the user.

To start an automatic measurement while a measurement is already in progress:

1. Press the **Advanced** key.
2. Select **Del Res.**.
3. Select **Auto Mes.**.

Addition of markers

To carry out a measurement, it is advisable to go into the **SETUP** menu and:

– activate the alarm thresholds in **Result Screens > Alarms**

– validate display of results on the trace in **Results on Trace = All**.

You can place markers of events on the trace at the exact position where you want to carry out automatic measurements.

You can also manually place markers in addition to those positioned automatically during automatic measurement. You can then start an automatic measurement to obtain the results on all the markers.

Representation of the markers

The markers are represented by the symbol : if they are set during automatic measurements or using the **Set markers** key.

The markers are represented by hte symbol if they are set during manual measurements in **Advanced** mode.

To add markers of events:

1. Select a cursor (A or B).
2. Use the direction keys to move the cursor to the place where you want to position a marker.

3 Press the key: **Add Marker**.

4 An event marker is displayed at the position of the cursor and a measurement is carried out on the marker. Measurement of slope before the marker starts just after the previous event (or at the end of the dead zone at the beginning of the fiber); measurement of slope after the marker stops just before the next marker or at the end of the fiber.

Hints on the positioning of markers

- Do not add markers (with the **Add Marker** key) after a manual measurement, as all the results will be recalculated automatically by the instrument.
- If two markers are too close together, they will appear on the trace and the table but no measurement will be carried out on the second marker: to obtain results for this marker, a manual measurement is necessary.
- If you press the **Add Marker** key when the cursor is very close to a marker, the latter will be deleted.

Deleting markers

To delete a marker, move the cursor on to the marker and press the **Add Marker** key. The marker selected will be deleted and a complete measurement, without this marker, will be carried out.

To delete several markers, use the **Event** key to move from one marker to the other, then press the **Add Marker** key as many times as necessary. The cursor will be automatically moved on to the successive markers.

Deletion of markers can cause incorrect measurement results.

Manual measurements

As soon as you have made an acquisition, with or without automatic measurement, you can make manual measurements on any event on the trace by means of the cursors A and B, in association with the functions of slope, detection of splice and calculation of ORL.

The manual measurements are accessible in the **Results** page, after pressing the keys: **Advanced**, then **Manual Measurement**.

Measurements of slope

To make a manual measurement of slope, press the **RESULTS** button to call up the trace and then:

– Place the cursor A at the beginning of the section of the trace where the slope is to be measured.
– Place the cursor B at the end of this section.
– Press the **Advanced** key, then the **Manual** key, then select **Slope**.
– Press ↵ : the slope of the specified trace section is displayed.

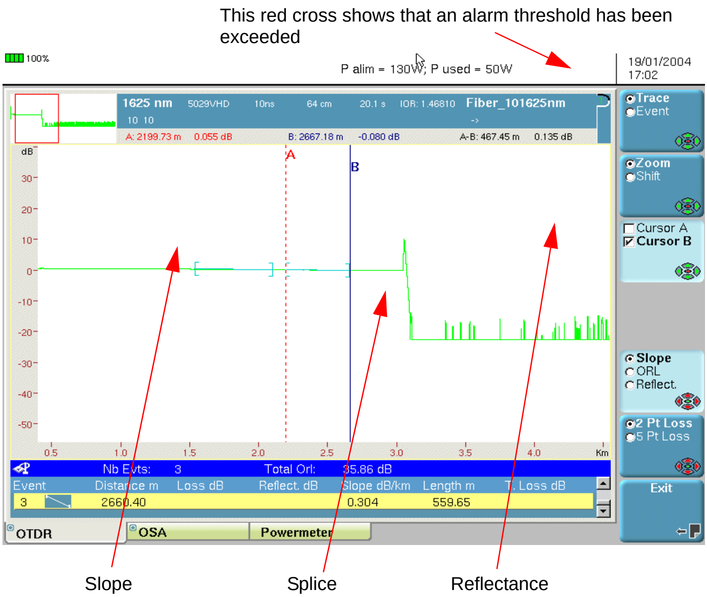


Fig. 23 Measurement results

Result of slope measurement

The result is displayed on the screen between the two slope indicators [and].

The measurement results are also available in the table which you can display in its entirety by selecting the **Table** function (after pressing **Exit** twice to quit **Advanced** mode). In the table:

– "distance" shows the distance between the beginning of the trace and the end of the slope;

– "section" shows the distance between the previous event (which may also be the beginning of the link) and the end of the slope. Thus this section value is not equivalent to the distance between the two slope indicators [and].
– "Slope" shows the slope value in dB/km

If no result is displayed in the table:

– the distance between the cursors A and B is too small.

Deleting a slope measurement

To delete a particular slope measurement result:

– superimpose the cursors A and B on the slope concerned
– select **Slope** (after, if necessary, pressing **Advanced** and then **Manual**).
– press : the slope of the specified trace section is deleted.

Performing splice and reflectance measurements

There are two methods of carrying out manual measurements of splices on the trace: the two-cursor method and the five-cursor method.

The five-cursor method is the more accurate, as it takes into account the difference of level between the slope before the splice and the slope after the splice. This method should be used whenever possible.

If very close events have created a dead zone preventing the measurement of slope by the five-cursor method, it is possible to use the two-cursor method. This considers the difference in level between the cursors.

Before performing one of these measurements, go into the **SETUP** menu and define the splice detection threshold (All is recommended). Also confirm display of the results on the trace (Results on Trace= All or Graphics only).

Two points method

To perform a splice measurement by the "two-points" method, display the Results page, then:

1 Place cursor A exactly on the fault, then place cursor B after the splice that you wish to define.

2 Press the **Advanced** key, then **Manual Measurement**, then select the function **2 Pt Loss**.

3 Press .

The splice marker is placed at the point defined by the first (left-hand) cursor and the result is displayed on the screen. If the fault is reflective, the reflectance value is also measured and displayed. These results are added to the table of results.

If no result is displayed, it is possible that the threshold of attenuation detection is higher than the attenuation that you are trying measure, or else you may have selected **No** or **Graphics only** on the **Results on Trace** line.

> **NOTE**
>
> If you try to measure a splice on a slope, the measurement is not carried out and the following error message is displayed: "Slope found between two cursors".

Five points method

To carry out a splice measurement by the "five points" method:

1 Measure the slope preceding the fault to be measured, then the slope following it.

2 Place the cursor on the fault (between the two sections).

3 Press the **Advanced** key, then **Manual Measurement**, then select **5 Pt Loss**.

4 Press .

The splice event marker is placed on the cursor and the result is displayed on the trace and in the table of results.

> **NOTE**
>
> If no result is displayed, it is possible that the display threshold of the attenuation measurement result is higher than the attenuation that you are trying to measure, or else, in the **SETUP** menu, you may have selected Results on Trace = None or Graphics only.

> **NOTE**
>
> If you try to measure a splice on a slope, the measurement is not carried out and the following error message is displayed: "Slope found between two cursors".

Manual measurement of ORL

It is possible to carry out an ORL measurement on a part of the fiber.

Follow the following procedure to measure a part of the fiber:

1. Position the cursors A and B to delimit the section that you wish to measure.
2. Press the **Advanced** key, then **Manual Measurement**, then select **ORL**.
3. Press . The ORL will be measured for the section of trace defined.

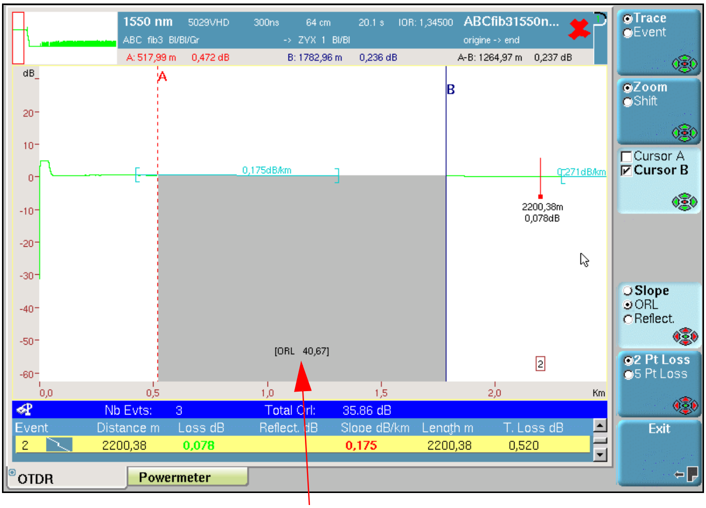


Fig. 24 Result of ORL measurement

ORL on a saturated trace

If saturation occurs during an ORL measurement, the result is given with the sign **<**. This means that the actual ORL value is less than the value displayed.

Memorization of the position of events

To memorize the position of events with a view to repeating the measurements at the same place during a future acquisition or on another trace, press the **Advanced** key, then select **Lock Evts**. The event memorization icon  will appear in the title bar.

The positions memorized will then be used in the subsequent measurements, either at the end of the manual acquisition, or when a stored trace is recalled.

> **NOTE**
>
> This function memorizes the markers placed on the current trace.

The following procedure is recommended to start a measurement with markers:

1 Carry out an automatic measurement.

2 Memorize the position of the events with the **Add Marker** key.

3 Add the manual measurements required (keys: **Advanced > Manual Measurement**).

CAUTION

If a marker is added (with the **Add Marker** key) after manual measurements have been performed, then all the markers on the trace will be converted into AUTO markers and an automatic measurement will be performed using these markers. The previous manual measurements will be lost.

Provided the event memorization icon  is displayed, the automatic measurement following the acquisition is carried out using the markers which were present before the acquisition.

If you wish to make a measurement without markers, deactivate memorization of events by pressing the **Free Evts** key.

Fault Locator Mode

Function

The Fault locator mode is used to detect the distance of the end of fiber from its origin. Consequently, il allows to detect a possible break of the fiber.

Choosing the function

1. Push the **SETUP** button
2. In the Acquisition parameters:
   - select the line **Mode**
   - Select **Fault Locator** with the direction keys (see "Configuring the reflectometry test" on page 44).

   or

   - Push the **Fault Locator** key, on the right of the screen.

NOTE

To go back to the standard mode, push the **Standard Mode** button or deselect **Fault Locator** in the Acquisition parameters.

Test configuration

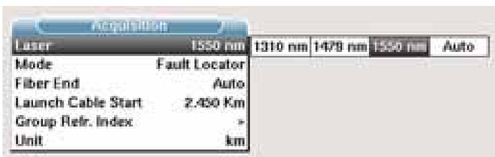


Fig. 25 Fault Locator Setup

To automatically set the measurement parameters, push the **Test Auto** key.

To manually set the test in Fault Locator mode, push the **SETUP** button. Five parameters have to be defined:

Laser	the wavelength of the signal (1310 or 1550 nm, 850 or 1300 nm, according to the module).

	Auto: by default, select 1550 nm for a singlemode fibre, and 1300 nm for a multimode fibre.
Fiber End	the attenuation threshold corresponael (from 2 to 20 dB). Modify the value using the direction keys or the numeric keypad. The Auto position is recommended.
Launch Cable Start	**No**: No launch cable used **Distance**: Manually enter the value using the numeric keypad, with the **Edit Number** key (Min= 0 km / Max= 10km/32.81 Kfeet / 6.22 miles) or Set the active cursor value using the **Set Cursor Distance** key.
Group Refr. Index	Fiber refractive index. You can: - choose one of the predefined value given for some cables (see table page page 48) . - manually define a refractive index: - either defining for each wavelength a refractive index between 1.30000 and 1.69999. The selection of an index modify the section AB value (real distance between the cursors A and B). - or, if you know the real distance between cursors A and B, entering this value in the Section AB line to know the refractive index of the fiber. This distance selection allows to display the indices. The extremes values of the distance are given by those of the indice (1.30000 à 1.70000)
Bend max.	Select the bend maximum value (in dB).
Unit	Distance unit (km / kfeet / miles)

Starting the test

Push the **START/STOP** button.

The test configuration starts automatically. Then a baragraph indicates the test progress and the number of acquisitions done.

You can stop the test at any time, pushing the **START/STOP** button.

Once the test is finished, the instrument measures the end of fiber distance and display it with the unit chosen. The Total Loss is also displayed.

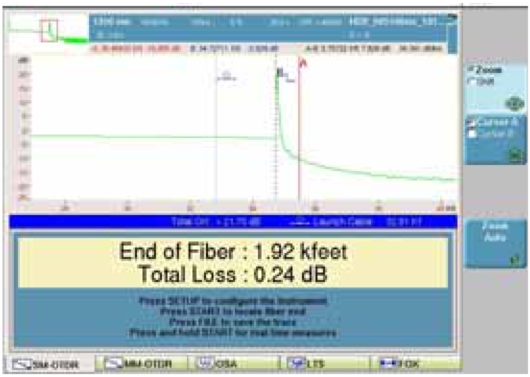


Fig. 26 Fault Location

Under the trace, in the blue line, are displayed:

– the ORL value of the link
– the Launch Cable length (if defined)

If one or several bends have been detected, the screen displays the 3 first macro bends detected, as well as, for each one, the distance and the delta loss between the two wavelengths (dB).

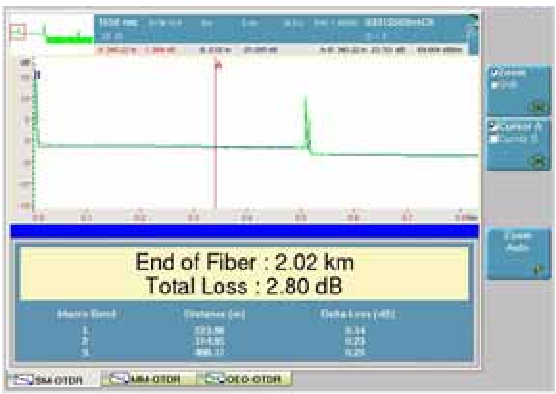


Fig. 27 Fault location Bend.

The reflectometry trace is displayed with, in addition, a dotted vertical line set on the end of launch cable  (if the Launch Cable is defined in the **SETUP** menu) and a dotted vertical line on the end of fiber .

The **Cursor** and **Zoom** keys are available.

Save the trace pushing the **FILE** button. Once the trace is saved, it can be recalled and displayed :

– either in OTDR mode (with analysis) if the **Standard Mode** is selected in the configuration menu.
– or in Fault Locator mode (with indication on the end of fiber) if the **Fault Locator** mode is selected in the configuration menu.

File Management

Storing OTDR measurements

Once the measurements have been made, results can be stored on different storage media.

If you had entered Auto store, then the results will be saved automatically.
If not, or if you want to store the results under another name, directory etc.:

1 Click on the **FILE** key
2 Select **Setup** with the key **Setup/Explorer**.
3 Modify the parameters you want
4 Click on **Store Trace**

The OTDR traces are stored with the extension ".SOR".

Recalling OTDR files

Once a OTDR file has been stored, recall it using the Explorer:

1 Select **Explorer** with the key **Setup/Explorer**.
2 Using directions keys, select the directory and then the file to open
3 Click on **Load**
4 Click on **View Tace(s)** or **Load Trace + Config.**

The selected file is opened

For further informations on file management, see Chapter 13 “File management’ on page 219.

Bi-directional OTDR

5

This chapter describes the different steps to perform an automatic bi-directional measurement (also called OEO measurement = Origin-End-Origin).This measurement requires that two 8000 Base Units are connected at each extremity of the fiber under test. Every Base Unit must be equipped with the software option called «OEO-OTDR» and with both optical talkset and OTDR plug-in.

> It is strongly recommended that the same type of OTDR is used (same reference) at each extremity of the fiber.

The topics discussed in this chapter are as follows:

Definition of terms used

Master / Slave unit

The master unit is the Base Unit that initiates the measurement at one extremity of the fiber.

The slave unit is the Base Unit connected on the other extremity of the fiber, and connected to the master unit via the data connection.

Local / remote unit

These terms are used in the Process Display page (see "Process page display" page 84). Each unit is considered «Local» on its own screen.

NOTE

These terms are to be distinguished from the measurement direction and extremities of the fiber (see "Fiber information" page 223)

Description of the measurement

NOTE

The measurement principle and methods used are described in "Principle of bi-directional measurement" page 4.

Thanks to the software option OEO-OTDR, bi-directional measurement can be fully automatic.

A minimum of two fibers is required. Two Base Units equiped with the talkset option and an OTDR plug-in are linked at every extremity of the fiber to test at the same time. A data connection is established between the two talkset ports of the units via another fiber, in order to exchange orders, configurations and measurement results.

NOTE

For automatic bidirectional OTDR testing, two units having the talset option and the E80 bidirectional option are rquired.

Example with 80000 series

Fully automatic bi-directional acquisitions can not be performed without a data connection (see ***«Data transfer»*** in the user manual of the Base Unit, reference 8000M02 for example).

Please check that the OTDR function has been selected (see "Selecting the function" page 44).

For best measurements and in order to qualify the fiber link and connectors, launch cables shall be inserted between the OTDR modules and the link.

Summary of the automatic operation procedure

- Test if both units are linked to the same fiber
- Consistency verification of the OTDR plug-in between the two units.
- Consistency verification of acquisition configuration, measurement and files, fiber and link definition. Then transfer of the master unit configuration to the slave unit if necessary.
- Acquisition start on the master unit
- Trace transfer to the slave unit
- Acquisition start on the slave unit
- Trace transfer to the master unit
- Bi-directional measurement on both units
- Results storage in a single «.OEO» file or in two «.SOR» files.

All this test procedure is fully automatic, and all results are immediately accessible on both units.

Configuration of bi-directional measurement

To access the OEO configuration menu, press the button **SETUP** from the Base Unit. OEO parameters are now displayed.

> Please check that the OEO-OTDR tab has been selected.

Acquisition parameters are the same as for OTDR measurements (see "Configuring the reflectometry test" page 44 for their description). Only different or extra parameters are presented here in this chapter.

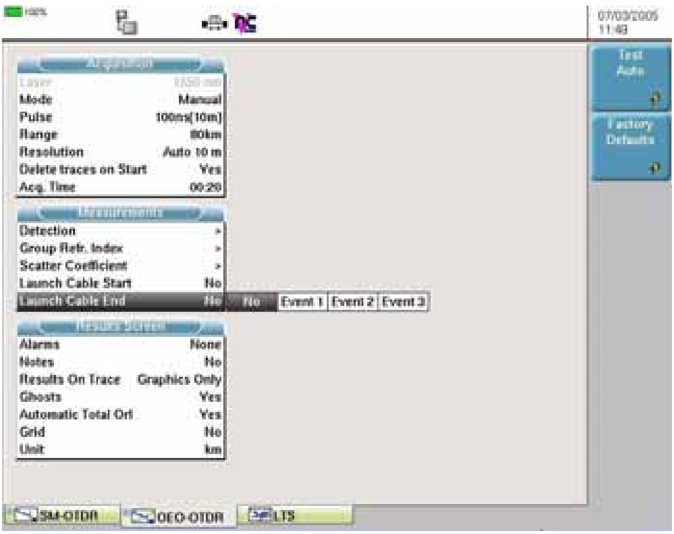


Fig. 28 OEO test setup menu

Acquisition parameters

Laser	Acquisition will be performed on all selected wavelengths, as long as they are available on the remote OTDR as well. If not, acquisition will be performed on all wavelengths selected and common to both OTDRs. Please see the recommendation on page 78 about using the same type of OTDR)

Mode	Bi-directional measurement allows manual and Auto modes only. Operation is the same as for OTDR measurement.

Measurement parameters

Launch cable start/end

This option allows the user to declare and describe the launch cables at the OTDR side of the other end of the fiber.

No	No launch cable on Remote OTDR.
Evt1,2,3	Declaration of a launch cable on the remote OTDR, distance given from selected event 1, 2 or 3. Results related to this launch cable are eliminated from the table.
Distance	Use the **Edit Number** key to enter a distance (Min= 0 / Max=1 10 km / 32.81 kfeet / 6.22 miles).

Default value : No

Results Screen parameters

Alarms	the alarms applie to the measurements average, and not to the measurements for each side (as it is in the classical OTDR mode)

Configuration of files parameters

To access the files configuration menu of the OEO-OTDR tab, press the button **FILE**.

Related parameters are then displayed.

All parameters to describe the files, the fiber and the link are proposed in order to save all measurements. Please refer to "File configuration menu" page 220. Only differences are presented in this chapter.

File Type

This option allows to choose to save a bi-directional measurement under two different formats (see "File management" page 90) :

A «.OEO» file	The bi-directional measurement is saved in a single file
Two «.SOR» files	The bi-directional measurement is saved in two different «.SOR» files

> **NOTE**
>
> For best use, it is recommended to use the auto file naming (with fiber code, origin, end, lambda, fiber name and auto-store). These parameters are applied on the master Base Unit.

Performing a bi-directional measurement

Process Display

The **Process** page displays the bi-directional measurement steps, whereas the **Curve** page displays the traces and results.

In order to display the **Process** page, make sure you are currently under the OEO-OTDR tab, and press the key **RESULTS**.

The key **View Curves/View Process** allows to change from the **Curve** page to the **Process** page and vice versa.

In order to select and follow the status of a measurement, go to the ***Process*** page.

> **NOTE**
>
> When a measurement has been started, the slave Base Unit automatically displays the **Process** page.

The **Process** screen is divided in three zones :

1 Information zone:
- Representation of the local Base Unit, with identification[1]
- Representation of the distant Base Unit, with identification[2]
- Status of the data connection : grayed when the link has been cut or the connection not yet established, yellow when the connection is operational
- Status of the fiber connection : this is the status of the last tested fiber. The fiber is represented cut and is grayed if the two units are not connected on the same fiber. If the two units are connected on the same fiber, the link does not appear cut. When a measurement is processed, the fiber is displayed in red
- When the fiber connection is established, information providing the module type and available wavelengths is displayed for both ***local*** and ***distant*** units

2 User guide zone:

A blue banner is displayed in the center of the screen where operation messages are displayed.

The icon for keeping all events in memory is displayed in this zone if the key **Lock Evt/Free Evts** is set on **Lock Evt.** In this case, the following measurement is performed using those markers (see "Memorization of the position of events" page 71)

NOTE

This function keeps markers in memory for both local trace and distance trace.

3 Measurement status zone :

When a bi-directional measurement has been launched, all the different steps in the measurement process are presented in this zone. Each one is detailed later in this chapter.

NOTE

The general information banner is displayed at the top of the screen as for all other tabs. When a OEO measurement is performed, Data and Remote mode icons are displayed as soon as a data connection is established.

1.includes the serial numbers of the mainframe and module as well as available wavelengths
2.requires active data connection

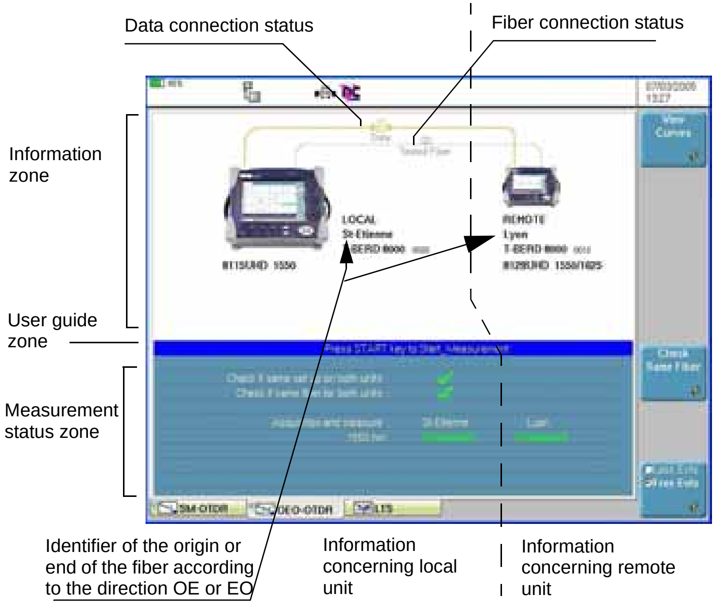


Fig. 29 Process page display

Fiber link check

To ensure that the two units are connected to the same fiber under test, select **Check same fiber**. If the fiber is the same at both extremities, a  symbol will be displayed on the measurement status zone.

Measurement process

Fiber measurement

Step 1.

– Choose to use the markers stored in memory or not by selecting **Lock Evt** or **Free Evts**.

> **NOTE**
>
> If the markers events are already defined for the link, you may select the **Lock Evt** key. This implies that the unit will now perform measurements with those markers. Otherwise select **Free Evts**.

– Press **START** to begin the measurement.

The line Verify if same set up on both units becomes In progress... .

NOTE

A warning may occur if the configurations of the two units are different (see "Warning/errors resulting from checking common configurations" page 92).

The ***begin*** launch cable is transferred to the ***end*** launch cable, and the ***end*** launch cable is transferred to the ***begin*** launch cable. The master Base Unit must indeed know both extremities of the fiber and will send the information to the slave Base Unit. The direction of the link is defined by the master Base Unit, which transmits the opposite direction to the slave Base Unit.

In the **File** configuration, each Base Unit points to its own directory. Only the master Base Unit may save a measurement. ***<Auto storage>*** and ***<File type>*** parameters only concern the master unit and are not compared or transferred to the slave Base Unit.

The list of lasers for which a measurement will be performed is set by the master Base Unit. If these lasters are not all available on the slave Base Unit, the list shall be restricted to the ones that are available.

When both menus **SETUP** and **FILE** are identical, the validation symbol  is displayed and the process goes to Step 2.

Step 2.

The line <Check if same fiber for both units> becomes <In progress...>. If the master Base Unit successfully detects the other Base Unit at the extremity of the fiber under test, the validation symbol is displayed, and the process proceeds to Step 3. Otherwise, the red cross  is displayed and the measurement is stopped.

Step 3.

The master Base Unit performs the acquisition using the first wavelength in the list. The message <In progress...> is displayed on each Base Unit, either in the ***«Local»*** column or the ***«Remote»*** column, depending on which Base Unit is considered. When the measurement is terminated, the message <Completed> is displayed. The trace is transferred to the other Base Unit.

Step 4.

The slave Base Unit performs the acquisition using the same wavelength. The message <In progress...> is displayed on each Base Unit, either in the ***«Local»*** column or the ***«Remote»*** column, according to which Base Unit is considered. The message <Completed> is displayed when the measurement is terminated,. The trace is transferred to the master Base Unit.

Step 5.

The bi-directional measurement is completed.

> **NOTE**
>
> The message <Impossible measurement> is displayed if the measurement has not been able to detect the end of the fiber on any of the two traces. The measurement must be performed once more with new acquisition parameters or by placing markers manually on the measurement.

Step 6.

Step 3.Step 4. and Step 5. are performed for each wavelength to test.

IMPORTANT

It is possible to stop the measurement at any step of the process, by pressing the button **START/STOP** on the master Base Unit.

It is also possible to request from the slave Base Unit that the measurement is stopped, by pressing the button **START/STOP**. The master unit receives the request via a message on the screen: <Remote asks for stop, do you agree ?>. If ***Yes***, the measurement is stopped, if ***No***, the measurement resumes.

Trace display functions

Selection :
- Local
- Remote
- Bi-Directional

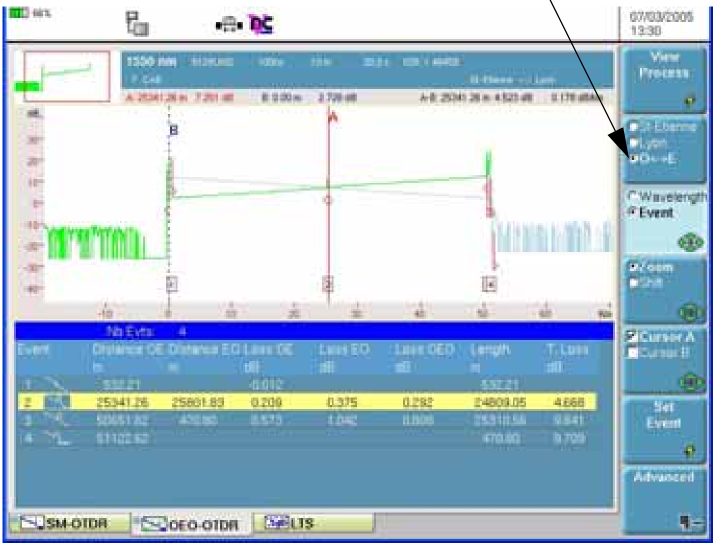


Fig. 30 Butterfly representation of the bi-directional measurement

By selecting the **View curve** key, the unit displays the traces and results like in classical OTDR mode, adding bi-directional measurement results.

In the **Curve** page, the multi-choice key  [1] allows to visualize successively the local trace, the remote trace, or both superposed.

> **NOTE**
>
> The remote trace is reversed in order to superpose both traces in a «butterfly fashion» (see "Butterfly representation of the bi-directional measurement" page 87).

1.In our example, St-Etienne corresponds to the extremity connected to the local unit, Lyon corresponds to the extremity connected to the remote unit.

NOTE

You may only use this key to change page when the measurement is completed. When the measurement is completed, the **Curve** page corresponding to the local Base Unit is automatically displayed (***Origin*** if the direction of the link has been defined O->E, ***End*** if the direction of the link has been defined E->O).

Origin and End traces

Bi-directional measurement may be performed using up to 4 different wavelengths. We can therefore analyze successively up to 4 couples of Origin and End traces.

In order to go from one couple to another, activate the **Wavelength/Evt** key, select **Wavelength**, and move from one trace to another using arrows.

These traces are OTDR traces. All regular OTDR functions are proposed to modify the display (Zoom/Shift, Cursors, Evt, Curve/Table, Full scale,...).

Just like in OTDR mode, the user will be able to work on these traces in order to analyze the fiber : by moving events, consulting the selected trace associated ***result table***, asking for an ***auto-measurement***, adding ***markers,*** and doing ***manual measurements***. See "Events" page 57, "Table of results" page 59, "Automatic measurement and detection" page 64, "Addition of markers" page 65 and "Manual measurements" page 66.

When the user comes back to OEO trace, all modifications that can have been done on either the Origin curve or on the End curve are now taken in account. The OEO measurement is performed again.

OEO trace

Only one couple of OE and EO traces is displayed, corresponding to one wavelength.

If the measurement has been performed on different wavelengths, select **Wavelength** on the key **Wavelength/Evt** in order to go from one couple of traces to another, using arrows.

Functions such as Zoom/Shift, Cursors, Evt, Curve/Table, Full scale... are all the same as for OTDR but the table result as well as the use of markers are specific to OEO measurements.

OEO Result table

Bi-directional measurement results use principles described in "Principle of bi-directional measurement" page 4.

The total loss of the fiber (on the line specifying the total number of events) is resulting from the average between the total loss calculated in the direction O->E and the total loss calculated in the other direction.

Three tables are available in the **OEO curve** page, each showing attenuation, slope and reflectance. In order to go from one table to another, use the **Advanced** key followed by the **Atten./Slope/Réflect.** key and select on of the three possibilities.

Automatic measurement and Addition of markers in OEO page

Key <Del Res/ Auto Meas> :

When this key is activated in the EOE page, and **Del Res**> is selected, OEO measurement is erased as well as OTDR measurement, for both origin and end traces.

When **Auto Meas** is selected, auto-measurement is performed once more for both origin and end traces, resulting in a new OEO measurement.

Addition of markers

In order to modify a marker on any of both origin and end traces, select cursor A or B, position your cursor when you want to modify or add a marker and press the key **Place marker**:

– If there was no marker at this position, a new one is added on both origin and end traces
– If there was two markers, one on each of both origin and end traces, both are deleted
– If there was only one marker, either on the origin trace or on the end trace, a second marker is added, on the trace when none was present.

Markers display

Markers  are available on the trace taken from the origin.

Markers  are available on the trace taken from the end.

NOTE

Acquisitions must be done with the same resolution. If not, the addition of markers can not be performed perfectly.

File management

Storing OEO measurements

At the end of a bi-directional measurement, the user has the possibility to save the origin trace as well as the end trace for each wavelength :

- either in a single «.OEO» file,
- or in two different «.SOR» files.

Traces may be stored manually or automatically on the master unit. They can be stored manually on the slave unit.

If you had entered Auto Store, then the results will be saved automatically.

If not, click on **FILE** to access the OTDR **File** menu and select the right format.
Then, press the **Store Trace** key.

Recalling OEO traces

Recalling a «.OEO» file:

If the OEO software option is available, loading a «.OEO» file with the **Load** key followed by **View Trace** key will open automatically the OEO-OTDR tab in order to display the OEO trace.

Recalling two «.SOR» files:

Wether the OEO software option is available or not, if the two «.SOR» files corresponding to a bi-directional measurement are selected, the key **Load Bi-dir.** appears. The OEO trace is then displayed.

> **NOTE**
>
> If both traces are not compatible (not performed using the same wavelength and pulse width), a error message is displayed <Acquisition parameters for these two files are different ! >

For further information on File management, see Chapter 13 “File management on page 219’

Test of a cable

In order to test a full cable, it is first necessary to make a OEO reference trace, where all fiber events have been marked on both origin and end traces. This trace may be obtained by requesting an auto-measurement after which markers may be added, or by performing a manual measurement.

The next step consists in memorizing all markers, by selecting **Lock Evts** in the **Process** page.

> **NOTE**
>
> If the auto mode was set for the referencing, it is recommended to change to manual mode for the next fibers. This will ensure that setup parameters used for all the fibers will be the same than those used for the reference trace.

Finally, a bi-directional automatic measurement is performed for each fiber. Results are stored in either one «.OEO» file or two «.SOR» files.

Troubleshooting

Warning/errors after pressing the key START

Error message	Possible problem	Possible solution
No data link. Activate connection before START	No data connection	Go back to **System** page to establish a connection

Error message	Possible problem	Possible solution
No tab OEO-OTDR on remote 8000 Unit	No software option OEO-OTDR on remote Base Unit	Bi-directional measurement impossible if no software option on remote Base Unit
Remote 8000 Unit not ready	OTDR resource has not been selected	Go back to the System page on the remote 8000 Unit to select the OTDR function
No resource for remote 8000 Unit	OTDR resource is already being used	Stop measurement on remote 8000 Unit to free the resource
No response from remote 8000 Unitt	Data link problem	Check the data connection

Warning/errors resulting from checking common configurations

Message	Action possible
No common laser: acquisition is impossible	Select a Base Unit equiped with the same type OTDR plug-in
Lasers are different. Do you want to continue?	**Yes** : measurement will occur using selected lasers common to both Base Units. **No**: measurement is stopped.
Acquisition configs are different. Transfer config to remote?	**Yes** : the **SETUP** configuration is transferred and applied on the remote Base Unit. **No** : no configuration transfer, the measurement is stopped.
File configs are different. Transfer config to remote?	**Yes** : the **FILE** configuration is transferred and applied to the remote Base Unit. **No**: no configuration transfer, the measurement is stopped.

Message	Action possible
Acquisition and files configs are different. Transfer config to remote?	**Yes**: The **SETUP** and **FILE** configurations are transferred and applied on the remote Base Unit. **No**: no configuration transfer, the measurement is stopped

Optical Spectrum Measurement

6

This chapter describes the different stages in carrying out a spectrum analysis of an optical signal, or analyzing effects from an optical amplifier (EDFA type), by a Base Unit equipped with a 507XXX series module (and a 507Ext extension card) or with a 81WDM / 81WDMPMD module or with the OSA-16X / OSA-20X / OSA-30X series.

> The OSA-16X / OSA-20X / OSA-30X are only available on MTS / T-BERD 8000 platform.

The topics discussed in this chapter are as follows:

1.Erbium Doped Fiber Amplifier

Configuration of the instrument

After connecting the fiber to be tested to the optical connector, you must select the OSA module (see the Base Unit manual).

WDM / OSA test configuration

To configure the Base Unit in preparation for an OSA test on a fiber, press the **SETUP** button.

The various measurement parameters are proposed:

1 either choose the default values by pressing the <Test Auto> key.

Configuration of acquisition in Test Auto mode:

- Sweep: Single
- High Sensitivity: Auto
- Averaging acquisition: No
- Resolution: Full
- Long term: No

Configuration of measurements in Test Auto mode:

- Channel detection: Permanent
- Signal threshold: Auto
- SNR
  - SNR method: Left and Right.
  - S <-> N distance: Auto
  - Noise acquisition bandwidth: 0.100 nm.
  - Splitter compensation:
    - Value: No
    - Unit: dB
  - Tilt & Slope Gain: No

Configuration of the result screen in Test Auto mode:

- Grid: Default value = last value used
- Alarms: No
- Wavelength range: Auto
- Table Notes: No
- Unit: nm

Configuration of the file set-up (see "File management" page 219)

– File name : [Cable_id][Fiber_Num][Test_Point][Direction]

– Auto Store : Yes

– Auto Fiber Increment : Yes

2 or define your own configuration.

The parameter to be modified must be selected by means of the direction keys . The possible options then appear on the screen: make your choice using the direction keys and .

The various parameters proposed are defined below.

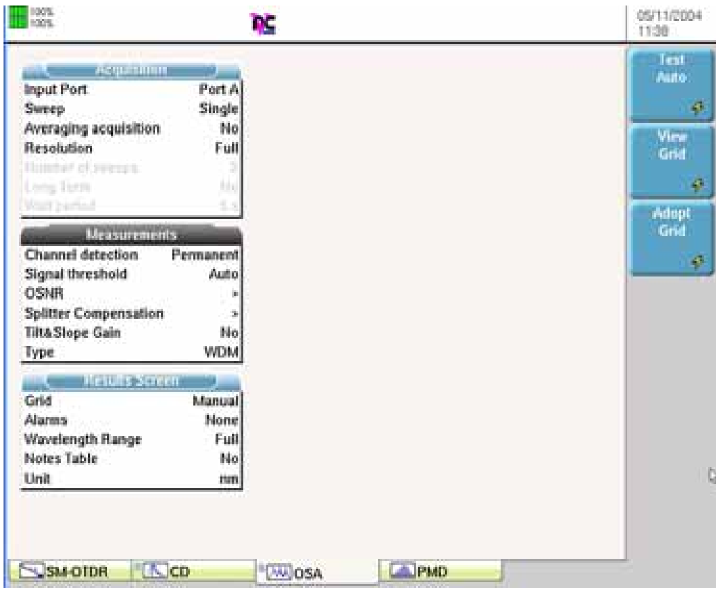


Fig. 31 Configuration screen for optical spectrum measurements

Acquisition Parameters

> **NOTE**
>
> With 507XXX series and 81XXX series modules, a warning message appears and the signal is cut off when the power of a channel is greater than 10 dBm or when the composite power of the input signal is greater than 20 dBm.

Input port

This line only appears when the OSA201 module is used.

The choices are:

- A: acquisition on port A
- B: acquisition on port B
- A+B : : acquisition on both ports

Acquisition band (only appears when 81WDMPMD module is used)

- OESCL Acquisition will be performed on full band.
- SCL Acquisition will only be performed on S, C and L bands.

Sweeps

- ContinuousThere will be a measurement with refreshment of the trace and real time display of the results:
  - every three seconds with plug-in 81WDM[1].
  - every 1.5 seconds with modules OSA-16X / OSA-20X / OSA-30X
  - every 6 seconds with plug-in 81WDMPMD[2]
- Single There will be one single measurement and the display of its result.
- Statistics In this mode, the number of samples concerned by the statistics must be entered (next parameter).
- Filtering only appears when using some modules of the series OSA-16X / OSA-20X / OSA-30X

High Sensitivity

Line not available on modules OSA-XXX.

1.normal mode and 1.5 seconds in real time mode.
2.normal mode and 3 seconds in real time mode.

- No — The range of power extends from +15 to - 65 dBm.
- Yes — The range of power extends from - 25 to - 75 dBm.
- Auto — Automatic detection of the range of power

Averaging

No, Weak, Average, Strong

This function can reduce the noise level of a value up to 5 dB. When the acquisition is averaged, a bar graph showing the state of advancement of the averaging is displayed at the bottom right of the screen.

Resolution

- Max maximum resolution of the filter (<0,1 nm).
- 0.1/0.2/0.3/0.4 or 0.5 nm for 507XXX series and 81XXX series plug-ins.
- 0.1/0.2/0.3/0.4/0.5, 1, 2 or 5 nm for modules OSA-16X / OSA-20X / OSA-30X.

Number of sweeps

In Statistics mode, this must be selected between 2 and 1000.

Long Term

> **NOTE**
>
> A long term measurement can be done only if the **Sweep** parameter is on Statistic mode.

- No,
- Manual the measurement is done manually, once the key **Stop Wait** is pressed
- Period the measurement is automatically done, after the wait period selected (see hereunder).

Wait Period

The Wait Period parameter allows to enter a wait period before the measurement start (onlyactive if **Long Term** is positioned on <Period>)

- Increments of 5 seconds up to 1 minute, then increments of 1 minute up to 10 minutes, then increments of 5 minutes up to 60 minutes; then increment of 1 hour up to 24 hours.

Measurement parameters

> Those parameters are only linked to the current active fiber.

Type

– WDM Module is used to measure the optical spectrum of an optical signal. Standard WDM results are displayed in the results table. (See "Display of the WDM / OSA results" page 106)

– EDFA Module is used to analyze results from an EDFA. EDFA results are displayed in the results table. (See "EDFA results analysis" page 114)

– DFB Module is used to analyze results from a DFB. DFB results are displayed in the results table (See "DFB results analysis" page 117)

Channel Selection[1]

– Grid The grid serves as a detection reference: it must therefore be Regular, Manual, ITU DWDM or ITU CWDM.. The choice of grid takes priority over the choice Channel Selection. For example, it is not possible to choose Channel selection = Grid, if the option selected for the grid is «Without» or «Conventional».

– Permanent Automatic detection of the channel on each acquisition. In this mode the channels are always detected without making a reference measurement.

> **NOTE**
>
> At the end of an acquisition in permanent mode, it is possible to create a grid on the basis of the channels detected. To do this, press the key **Create Grid** in the **SETUP** menu**.**

Signal threshold [1]

Threshold of detection of channels (see "Channel detection threshold" page 108).

– Auto. the threshold is determined automatically.

1.Attention: all modification of these parameters has immediate repercussions on the trace and entails the loss of the measurement statistics.

– Manual from -79.9 to +10 dBm.

Use direction keys or **Edit Number** to modify values (Min=80 dBm / Max=10.0 dBm)

> **NOTE**
>
> Modification of the parameters **Channel selection** and **Signal threshold** will only modify the results if the WDM module present is the one that was used for the acquisition.

SNR parameters

To modify these parameters, go to the **OSNR** line. A sub-menu then appears proposing the following options:

– SNR method [1] Side of the peak where the point of reference for noise is taken (left, right, left and right).

– S<->N distance1 Distance between the peak of the channel and the point of reference for the noise.

– Auto: distance determined according to the spacing of the channels.

– 0.2/ 0.4/0.8 nm from the peak if the unit is nm

– or 25 GHz, 50 GHz,100 GHz from the peak if the unit is THz.

– Noise Acq. Bandwidth1 Reference bandwidth used for the acquisition of noise:

- standard 100 pm
- values lie between 10 pm and 10 000 pm.

Splitter compensation

When the measurement is made by the intermediary of a separator (also known as a splitter), it is possible to compensate for the loss introduced by this element and to display the value measured before or after it.

Go to the **Splitter compensation** line to display a sub-menu proposing the following options

– Value[1] Yes: activation of compensation and choice of its value using the keys ◀ and ▶: or the numeric keypad : from 1 to 30 dB (by increments of 1) or 1 to 99% (by increments of 0.1%).

1.Attention: all modification of these parameters has immediate repercussions on the trace and entails the loss of the measurement statistics.

– Unit Choice of compensation in dB or as a percentage of the value measured.

For example, with a 10 dB splitter, the results will be augmented by 10 dB. The trace will be offset upwards by 10 dB. A channel measured at -30 dB will be displayed -20 dB.

Gain Tilt and Slope

– No/Yes Validates measurement and display of the max. difference in gain (in dB) and slope of the gain (in dB per nm or by THz) above the trace.

Parameters of display and analysis of the results

> Those parameters are valid for all traces present on the screen.

Grid

Go to the **Grid** line to access the Grid sub-menu. Select the **Type** line to see the different choices and modify them if required.

Five possible types of grid are proposed with different corresponding values, some of which are fixed or non-applicable, others editable.

The type «Conventional» and the option «Without» do not give access to the parameters of the Grid sub-menu; the others give access to certain options, as shown in the table of the figure.

Table 1 Grid menu options for each type of grid

	ITU CWDM	ITU DWDM	Regular	Manual
Grid name	Editable	Editable	Editable	Editable
ITU standard	G.694.2	G.692	N/A	N/A
First ITU channel (with display in nm)	Editable, from 1270 to 1630 nm, by increments of 20 nm	Editable, from 1528.77 to 1560.61 nm, by increments corresponding to the channel spacing selected	Editable from 1260 to 1650 nm, by increments of 0.01 nm.	N/A
Channel spacing	20 nm	Editable, from 25 to 200 GHz	Editable from 20 to 1000 GHz by increments of 1 at each click, of 10 if key is held down	N/A
Number of channels	Editable, from 1 to 19 by increments of 1	Editable, from 1 to 21 by increments of 1	Editable, from 1 to 56 by increments of 1	Editable from 1 to 256
Define channels	Sub-menu accessible to display the wavelengths of each channel, name the band, and name each channel	Sub-menu accessible to display the wavelengths of each channel, name the band, and name each channel	Sub-menu accessible to display the wavelengths of each channel, name the band, and name each channel	Sub-menu accessible to display the wavelengths of each channel, name the band, and name each channel

> **NOTE**
>
> The maximum real number of channels for ITU grids depends on the value selected for the first channel and the spacing between the channels.

> **NOTE**
>
> It is possible to display the grid with the <View Grid> key. A table then appears showing the channel number, the name of the channel, the reference wavelength and the alarm thresholds for delta F, min. P, max. P and min. SNR.

Table Notes

– No/Yes Enables the display and entering of Notes in the table (see "Table notes" page 112).

Alarms

When **Channel Selection** is positioned on **Grid**, it is possible to activate an alarm system. This system is based on a system of thresholds. Any measurement results that exceed these thresholds are displayed in red in the table, and the icon  appears at the top right of the screen. If all the results are within the thresholds (no result is in red), the icon becomes .

To activate the alarm system, go to the <Alarms> line and select "Active".

Thresholds can then be set (using the direction keys or numeric keypad), to global level or to the level of each channel:

1 <Global alarms>

–Number of channels: Yes/No

–Max. variation level[1]: No or threshold modifiable from 0.1 to 60 dB

–Max. SNR variation[2]: No or threshold modifiable from 0.1 to 60 dB

–Max composite p. [3]: No or threshold modifiable from -59.9 dBm to +20 dBm

2 <Channel alarms>

– Maximum drift[4]: Yes/No

1.Max. acceptable variation between max. power and min. power on all channels
2.Max. acceptable variation between max. SNR and min. SNR on all channels
3.Maximum composite power

–	Min. Level (channel)[1]	Yes/No
–	Max. Level (channel)[2]	Yes/No
–	Min. SNR [3]:	Yes/No
–	Channel number:	From «001» to the max. number of channels.
–	Value of channel:	Display of the wavelength of the channel number selected
–	Delta F[4]:	From 0 to 2 THz (2 THz is the default value)
–	Min. P[5]:	From -80 dBm to +9.9 dBm (below max. threshold)
–	Max. P[6]:	From -79.9 dBm to +10 dBm (above min. threshold)
–	Min. SNR:	From 0 to 50 dB

Wavelength range

This line enables definition or display of the waveband that will be shown on the screen (see "Limited display band" page 107).

Table Notes

Here the display can be configured and it can be specified whether or not it is possible to enter a note for each channel (see "Table notes" page 112).

Units

Here the units of the x axis can be selected:

– Frequency in THz
– Wavelength in nm

4.Wavelength drift. Selection of the alarm on the basis of the value of delta F
1.The values are then defined in Min. P
2.The values are then defined in Max. P
3.The values are then defined in Min. SNR
4.Delta of frequency
5.Minimum power
6.Maximum power

Acquisition

The Base Unit has two modes of acquisition with 507XXX series and 81WDMXXX series plug-ins.

1 Fast acquisition: press the **START** key and hold it down for some time.

2 Normal acquisition: press the **START** key briefly.

Only «Normal acquisition» mode operates with modules OSA-16X / OSA-20X / OSA-30X. When acquisition is complete, an automatic measurement is performed.

Trace display functions

The trace acquired or recalled from a memory is displayed on the Results page: see example Figure 13 on page 30.

A range of functions enable modifications to the display of the trace (Cursors, Zoom/Shift, Event/Trace, Graph/Table, Full scale, etc.). See "Functions relating to display of a trace" page 35.

See "Overlaying several traces stored in memory" page 40 for overlay of traces.

Display of the WDM / OSA results

The results window, obtained by pressing the **RESULTS** button**,** shows different zones displaying, from top to bottom:

– the mini-trace in the upper part of the screen, accompanied by the principal characteristics of the acquisition and of the file if the result is stored in memory.
– the trace results associated with cursors A and B
– the trace proper (see "Trace display functions" page 106).
– the table of results (see "Table of results" page 110).

The trace represents power (in dBm) as a function of frequency (in THz) or wavelength (in nm). The channels detected are represented by peaks.

> **NOTE**
>
> If several acquisitions are performed, the trace displayed is the one corresponding to the last acquisition.

Limited display band

It is possible to a zoom on to just a part of the trace:

1 by defining the start and/or the end of the screen manually. To do this, go into the **SETUP** menu, choose **Wavelength Range** then position **Mode** on **Start/End**. You can then define the frequencies or wavelengths of the start and end of the desired display band.

2 by defining the center and the width of the spectrum manually. To do this, go into the **SETUP** menu, choose **Wavelength Range** then position **Mode** on **Center/Width**. You can then define the frequencies or wavelengths of the center and the width of the desired bandwidth either side of this center.

Successive zooms on the different channels

– Zoom on one of the channels as shown previously.

– Press the **Trace>/<Channel** key

– Use the ◀ and ▶ keys to move the zoom on to the successive channels.

<Graph> /<Table> key

This key offers a choice from the following displays:

– Trace alone:main display of the trace with a single line of the table at the foot of the page.

– Trace + Table:display of trace, reduced in size but followed by 5 to 8 lines of the table of results.

– Table: display of the table alone

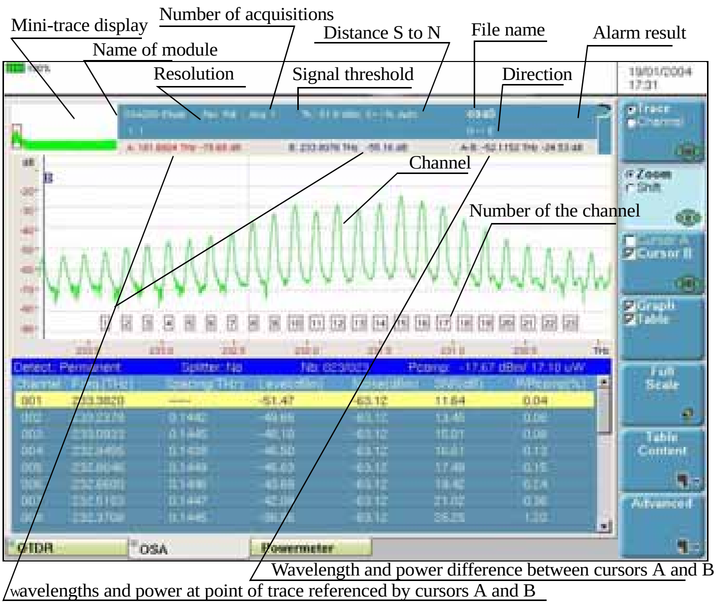


Fig. 32 Example of OSA test result (with grid)

Channel detection threshold

On the trace, some peaks corresponding to noise could be mistaken for channels. It is therefore necessary to fix a power threshold level: only peaks that exceed this threshold will be considered as channels and included in the table of results.

To display or modify this threshold, press the **SETUP** key, then select **Signal threshold**. Modify the value to position it on **Auto**[1] or fix a threshold value.

Display of a grid

The display window of the trace can include a grid to facilitate verification of the position of the channels. Several grids are possible (see the chapter "Parameters of display and analysis of the results" page 102)

1.The "Auto" value is obtained by continuing to reduce the value of the threshold below the minimum value of -79.9 dBm

Display of total power between cursors

To display on the trace the total power between the two cursors A and B:

– Place the cursors at the desired positions.
– Press the **Advanced** key, then **Total Power A<--->B**.
– The space between the trace and the two cursors is greyed out and the power is displayed in the form "P=-4.95dBm".
– Pressing the key **T. A<-->B** a second time removes the result of the total power measurement.

Display of gain Tilt (delta) and gain slope results

The Base Unit can display two additional results:

– The gain tilt, that is to say the difference between the max.and min. values of the peaks of the complete signal spectrum between the cursors.
– The gain slope measured by a method using a least squares algorithm.

To display these results above the channels:

– Confirm **Delta Gain & Slope** in the **SETUP** menu.
– Place the cursors at the desired position.
– Press the **Advanced** key, then **Delta/Slope A<->B**.

  The gain tilt is displayed in dB. Gain slope is traced and its value is displayed in dB/THz or dB/nm according to the units selected.

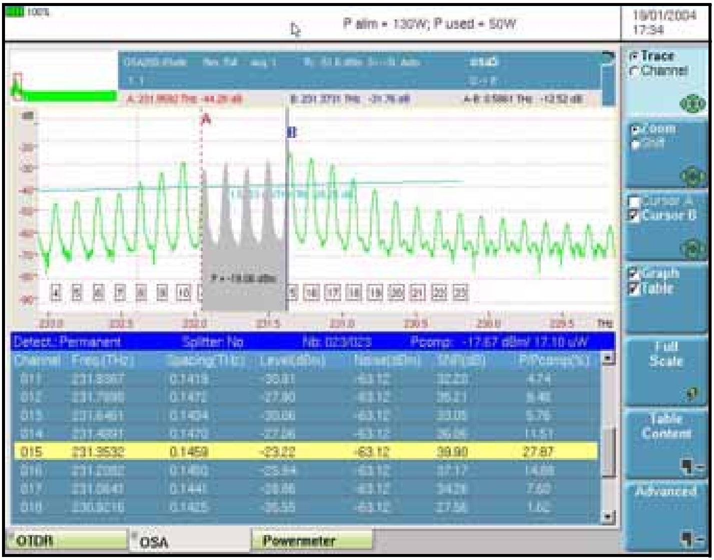


Fig. 33 Display of total power, gain tilt and slope of the gain between the cursors

Table of results

Lines

According to the choice made in the **SETUP** menu, the table of results may include:

– either a line for each channel detected (if Channel Selection = Permanent)

– or a line for each graduation, (if Channel Selection = Grid and a grid is selected)

Type of display

The table may be displayed in a single line, on half of the screen or the whole screen as a function of the <Graph>/<Table> key (see "<Graph> / <Table> key" page 107)

Contents of the table without statistics

In the absence of statistics (see "Measurement parameters" page 100) the parameters given for each channel are:

1. the number of the channel
2. the frequency or the channel wavelength according to the units selected.
3. the interval between the channels in THz or in nm
4. the level of power of the channel in dBm
5. the noise level in dBm
6. the SNR for the channel in dB
7. the ratio between the power of the channel and the composite power in%.

The contents of the last 5 columns of the table will be different if statistics are calculated. The values to which the statistics relate being frequency (or wavelength) and noise level or signal-to-noise ratio, the display will give current value, average value, max. value, min. value and standard deviation.

Contents of the table with statistics

If the test includes multiple acquisitions (mode 2..100 or Continuous mode), statistics are calculated on the results. To display these results in the table, press the **Table Contents** key, then **Statistics**.

Five **Statistics** keys are then available to choose what will be displayed in the table for each channel.

Without statist.	Channel	Freq. or Wavel.	Interval	Level	Noise	SNR	P/ Comp.P
Statist. Freq. or Wavel.	Channel	Freq. or Wavel.	Interval or Freq.ref or Wavel. ref	Av. F or Av. L	Max. F. or Max. L	Min. F or Min. L	Std. dev. F or L or value delta
Statist. Power	Channel	Freq. or Wavel.	Level	Av. P	Max. P	Min. P	Std. dev. P or value delta
Statist. SNR	Channel	Freq. or Wavel.	SNR	Av.SNR	Max. SNR	Min. SNR	Std. dev. SNR or value delta
Statist. Mixed	Channel	Freq. or Wavel.	Min. F or Min. L	Max. F. or Max. L	Level	Min. P	Max. P

Channel sort

The channels can be classified in the table in ascending order of frequency (or wavelength), level or SNR.

To modify this order:

– Press the **Table Contents** key, then **Sort**.
– Press **Freq Sort** (or **Wavel. Sort** according to the units selected), **Level Sort** or **SNR Sort**.

Successive addressing of channels according to the sort type selected

On the trace and in the table, it is possible to move the cursor from one channel to the next in the selected sort order. To do this,:

– Use the key **Cursor A>/<Cursor B** to choose the cursor A or B to be used on the trace.
– Press the **Channel** key
– Press ◀ and ▶ to move the cursor to the following or preceding channel:

Table notes

A note of not more than 40 characters, entered by the user, may be associated with each channel.

NOTE

Each note is associated with a channel. Consequently, if the channel is deleted, the note the will be deleted too.

NOTE

These notes appear in the table only if they have been validated in the **SETUP** menu on the **Table notes** line (Result screen). Similarly, this option must be confirmed in order to be able to create a note.

To enter a note:

– In the table, select the channel.
– Press the **Table Contents** key, then press **Notes**.
– Enter the text of the note and confirm its creation.
– Press the **Exit** key to return to the previous menu if necessary.

Displaying relative results

By default, the table gives the results in absolute values. To obtain these results in relative values with respect to a reference channel:

– Press the **Table Contents** key, then **Relative>/<Absolute** to select **Relative**.
– Move the cursor on to the channel that is to serve as the reference.
– Press the **Define Ref. Channel** key. The results are recalculated with respect to this channel of reference.

> **NOTE**
> On quitting this menu, the table automatically reverts to the display of absolute values.

Channel filtering

Field of application

This option applies solely to instruments OSA-16 / OSA-20 / OSA-30 and OSA-303.

It is used to filter out one particular channel and extract it via a port called the "drop port".

Modules OSA161 and OSA301 are equipped with an input port A and a drop port.

Module 83OSA201 is equipped with two input ports A and B and a drop port.

Only input port A on modules OSA161 and OSA301 can extract a channel to the drop port.

Only input port B on module OSA201 can extract a channel to the drop port.

Configuration

To obtain filtering of a given canal to the drop port, go into the**SETUP** menu of the OSA module. Choose **Acquisition**, then **Sweeps** and select **Filtering**.

The options of the acquisition menu then change and offer:

– Choice of channel

In the Choice of Channel option, either a value may be entered manually or the current value from the table can be taken.

– Manual: A new line appears above choice of channel, in which the required value can be entered.
– Table: The value of the current selection in the results table is used automatically. To vary this selection, go the the result screen and use **Table contents**.
– Channel value

Here the manual value of the filtering to be performed can be entered using the direction keys ◀ and ▶. or the numeric keypad

– Tracking

This option, when selected, makes it possible to follow the peak of the filtered channel, even if this varies slightly in wavelength.

The information «Locked» appears as long as the channel remains within the tolerance limits of the instrument. If the channel strays outside the tolerance band, the information «Unlocked» appears.

Using channel filtering

After setting sweep mode (in the acquisition menu of the **SETUP** screen) on **Filtering**, press the **START/STOP** button to start or stop filtering of the signal.

EDFA results analysis

The results analysis of an EDFA consists in performing two spectrum analysis: one before the signal is amplified and another one after the signal is amplified. Both traces are further compared, providing the resulting power gain and noise figure.

EDFA test configuration

To configure the Base Unit in preparation for an EDFA test, press the **SETUP** button.

In the Measurements section, set **Type** on «EDFA».

Other **SETUP** parameters are the same for EDFA as for WDM measurements. Refer to "WDM / OSA test configuration" page 96 for a complete description.

> **NOTE**
>
> If your Base Unit is equipped with an OSA201, you may use the two ports to test before and after the EDFA. In this case, make sure you select «Port A+B» for **Input Port**.

EDFA measurements

Measurement procedure, using one port :

If only one port is selected, the Base Unit is ready to perform the «Acq. ***in»*** (signal before being amplified by EDFA).

– Connect your Base Unit to your fiber before the EDFA.
– Click **START/STOP** to perform the first acquisition.
– Switch to **Acq. Out**.
– Connect your Base Unit to your fiber after the EDFA.
– Click **START/STOP** to perform the second acquisition.

Results appear automatically in the table.

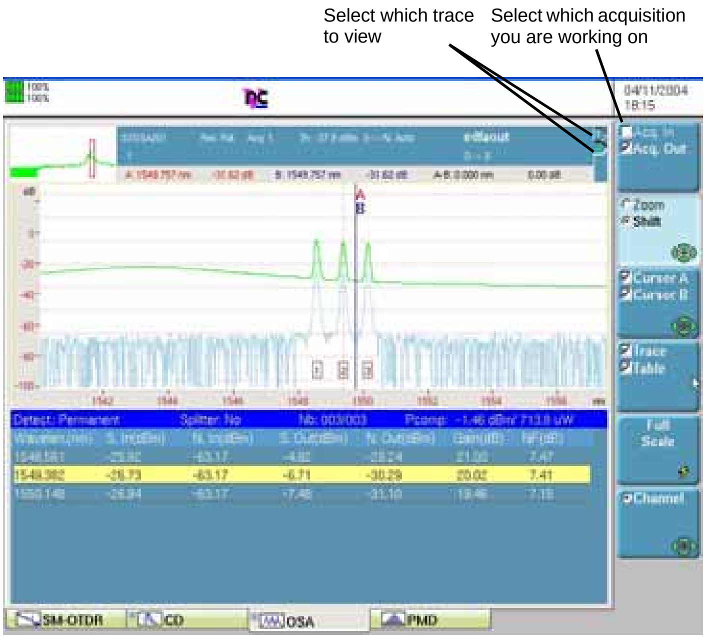


Fig. 34 EDFA measurements

Measurement procedure, using two ports :

If two ports are selected, the Base Unit will perform both «Acq. ***In»*** and «Acq. ***Out»*** in one step.

– Connect your Base Unit to your fiber before the EDFA on port A and your fiber after the EDFA on port B.
– Click **START/STOP** to perform both acquisitions.

Results appear automatically in the table.

EDFA results

A table is displayed (see "EDFA measurements" page 116) showing for each channel:

– S. In:Signal power before EDFA (expressed in dBm)
– N. In:Noise level before EDFA (expressed in dBm)
– S. Out:Signal power after EDFA (expressed in dBm)
– N. Out:Noise level after EDFA (expressed in dBm)

– Gain:Power gain from EDFA (expressed in dB)
– NF:Noise figure from EDFA (expressed in dB)

<***Channel***> allows to move the cursor from one channel to another, both in the trace and in the table of results.

Saving EDFA results

Results are not saved in a file. Nevertheless, both traces may be stored as regular WDM traces.

To save your files:

– Select **Acq. In** to save the first file
– Click on **FILE**, select name and **Store Trace**
– Click on **RESULTS** to come back to the previous screen
– Proceed the same way for **Acq. Out**.

Loading EDFA results

Results are not saved in a file. Nevertheless, both traces may be reloaded as regular WDM traces. Results will be automatically recalculated.

– Select **Acq. In** before loading your first file
– Click on **FILE** and **Explorer** to select your file
– **Load** and **view** your trace

  The first trace is now loaded for <Acq. In>.
– Select **Acq. Out** before loading the second file and proceed the same way to load the second file.

Results appear automatically in the table.

DFB results analysis

This feature applies solely to instruments OSA-16X / OSA-20X / OSA-30X.

DFB results analysis allows to characterize DFB lasers, by giving the corresponding SMSR, Offset and bandwidth values (see the measurement principles in "DFB analysis" page 6).

DFB test configuration

To configure the Base Unit in preparation for an DFB test, press the setup button.

In the Measurements section, set **Type** on DFB.

A new DFB sub-menu is offered while other Setup parameters are the same for DFB as for WDM measurements. Refer to "WDM / OSA test configuration" page 96 for a complete description.

DFB (sub-menu)

- Bandwidth level — Level (expressed in dBc) where the main component bandwidth should be calculated
- Min SMSR — Minimum offset value to consider to find the Side Mode
- Max SMSR — Maximum offset value to consider to find the Side Mode

DFB measurements

Measurement procedure:

- Use a patchcord to connect your DFB laser source to an input port of the OSA-16X / OSA-20X / OSA-30X module on the Base Unit.
- Power on the DFB laser source.
- Click **START/STOP** to perform the acquisition.

The trace and corresponding results appear automatically after a few seconds.

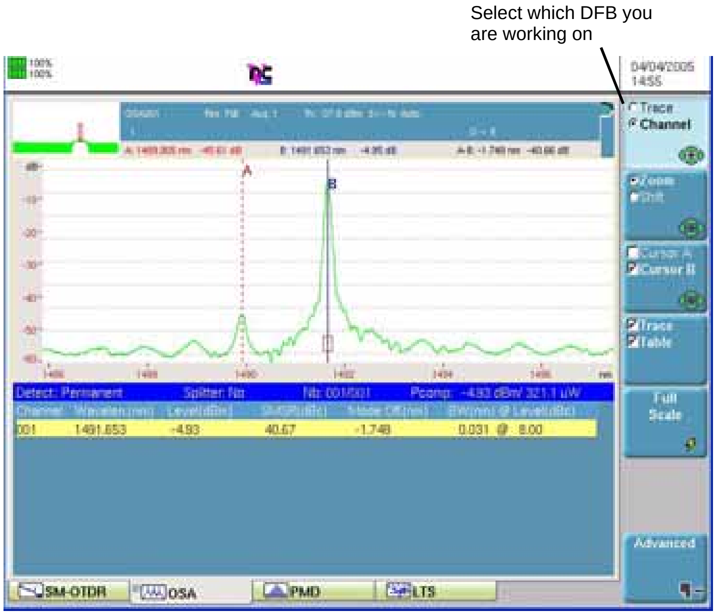


Fig. 35 DFB measurements

Cursors A and B are automatically positioned on the first DFB laser, respectively on the max SMSR and the pick of the main component.

DFB results

A table is displayed (see "DFB measurements" page 119) showing for each DFB:

– Channel: Number of DFB laser detected

– Wavelen: Wavelength (expressed in nm) of the DFB main component

– Level: Peak amplitude (expressed in dBm)

– SMSR: Side Mode Suppression Ratio (expressed in dBc)

– Mode off: Mode Offset (expressed in nm)

– BW @ level:Calculated bandwidth (expressed in nm) according to the bandwidth level (expressed in dBc) defined in the setup menu.

When the <***Channel***> key is selected, use the arrow keys ◀ and ▶ to move the cursor from one DFB pick to another[1], both in the trace and in the table of results.

Saving DFB results

DFB Results are not saved in a file. Nevertheless, the trace may be stored as a regular WDM trace.

To save your files:

– Click on **FILE**, select name and **Store Trace**

– Click on **RESULTS** to come back to the previous screen

Loading DFB results

Results are not saved in a file. Nevertheless, the trace may be reloaded as a regular WDM trace. Make sure Type> is set on **DFB** in the setup menu to recalculate DFB results.

Results appear automatically in the table.

File Management

Storing OSA measurements

If Auto store has been selected, then results will be saved automatically. If not, or if you want to save the results under another name, directory etc.:

1 Click on **FILE** key

2 Select **Setup** with the **Setup/Explorer** key

3 Modify the parameters you want

4 Click on **Store Trace**

The trace is saved with the extension ".OSA"

Recalling OSA files

Once an OSA file has been stored, recall it using the **Explorer**:

1 Select **Explorer** with the key **Setup/Explorer**.

2 Using directions keys, select the directory and then the file to open

3 Click on **Load**

1.In case several DFB lasers are characterized at the same time

4 Click on **View Tace(s)** or **Load Trace + Config.**

The selected file is opened

For further informations on file management, see Chapter 13 “File management”.

Polarization Mode Dispersion Measurement

7

This chapter describes the different steps in carrying out a PMD measurement with a Base Unit equipped with a 5073PMD or 5073WDMPA plug-in (and with a 507XExt extension card), with a 81PMD / 81WDMPMD module or with the OSA-16X / OSA-20X / OSA-30X series[1]

The topics discussed in this chapter are as follows:

It is assumed that you are familiar with the operation of the Base Unit, the OBS-15 (Optical Broadband Source) and the OVP-15 (Optical Variable Polarizer) options.

1.Equipped with PMD test kit option

Recommended equipment

To perform a PMD measurement, the following equipment is recommended:

– Base Unit with a module or plug-in as mentioned above, and associated optical connectors.
– OVP-15 Optical Variable Polarizer ± 90° with associated optical connectors, for 5073XXX plug-ins and OSA-16X / OSA-20X / OSA-30X series modules[1].
– OBS-15 Optical Broadband Source, output power level 0 dBm with associated optical connectors, or E81BBS1 or E81BBS2 optical Broadband Sources..
– Visual Fault Locator (VFL) with associated optical connector.
– Fiber scope with associated optical connectors.
– Cleaning kit.
– Two jumpers with associated optical connectors.
– One coupler.
– Communication tool (either GSM or telephone, or optical talk set).

NOTE

A description and methods used to measure the Polarization Mode Dispersion (PMD) is described in "PMD principle" page on 7.

NOTE

The PMD value obtained by the fixe analyzer method is the mean PMD value, also desingated as «expected PMD value».

PMD test setup menu

After connecting the fiber to be tested and all the equipment is switched on and ready for use, you will then need to set up the Base Unit to perform a PMD measurement.

To access the PMD test setup menu, press the **SETUP** button on the Base Unit. The different measurement parameters are displayed.

1.81XXX plug-ins offer an integrated polarizer, therefore don't require an OVP-15.

You may:

- either choose the default values by pressing the **Test Atuo** skey.
- either define your own configuration.

Test Auto Configuration

In Test Auto configuration, the setups below are provided.

Setup menu

ACQUISITION

- Sweep : Single
- Averaging acquisition: Auto
- Make reference : No[1]
- Reference date
- Long term: No

MEASURES

- Coupling : Strong

RESULTS SCREEN

- Alarms: None
- Spectral Unit: nm

File Menu

- Filenaming: Auto : [Cable_Id][Fiber_Num][Direction]
- Autostore: Yes
- Fiber Nbr Increment: Yes

Manual Mode Configuration

In standard mode, you can set your own parameters..

1.Does not concern 81XXX plug-ins.

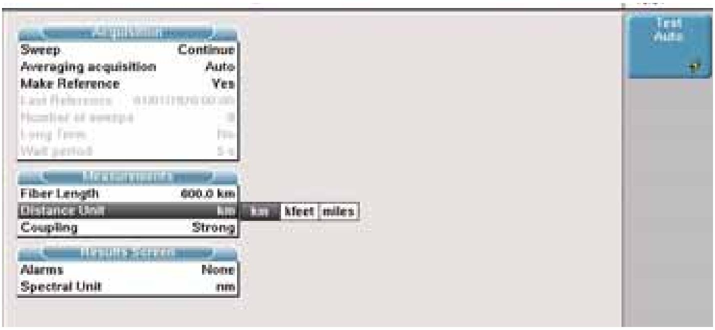


Fig. 36 PMD Test setup menu

The different parameters proposed are described below.

Acquisition parameters

> **NOTE**
> When the composite power of the input signal is higher than 20 dBm, a warning is displayed and the signal is cut off.

Acquisition band (only appears when 81WDMPMD module is used)

OESCL	Acquisition will be performed on the full band.
SCL	Acquisition will only be performed on S, C and L bands.

Mode

Continue	There is a continuous measurement with a trace refresh and a real-time display of the results.
Single	There will only be one measurement and display of the result.
Statistics	A set of measurements can be performed providing statistics or results. This mode also gives access to the two following parameters (Wait period and Number of samples).

Averaging acquisition

(to improve the dynamic range of the unit)

No	No average of the acquisition sample to be performed.

Low	Low averaging (4 samples).
Medium	Medium averaging (16 samples).
High	High averaging (32 samples).
Auto	The average low, medium or high measurement is automatically selected during the reference.

NOTE

An increase of the averaging can improve the dynamic range to up to 5 dB.

Make Reference[1]

Yes:	Option to select if you wish to perform a reference before the PMD measurement
No:	Default option. The instrument automatically sets back to this option after the reference has been performed.

The date of the last reference is displayed below this field.

Long term

Wait period between two consecutive samples, in statistics mode:

None	samples are displayed one after the other;
Manual:	requires the user to press the **Stop Wait** button to start the next sample. This mode is used for example, if you wish to set the polarizer value between each acquisition.
Period:	A new line Wait becomes available when Yes is selected.

Number of samples

Number of acquisitions from 2 to 100.

Wait

The Wait Period parameter allows to enter a wait period before the measurement start (onlyactive if **Long Term** is positioned on **Period**)

– Increments of 5 seconds up to 1 minute, then increments of 1 minute up to 10 minutes, then increments of 5 minutes up to 60 minutes; then increment of 1 hour up to 24 hours.

1.Does not concern 81XXX modules

Fiber parameters

Fiber length (Edit Number: Min=0.100 km / Max=300 km)

The fiber length must be set to provide the PMD coefficient.

Unit

Km	Distance unit defined in kilometers.
Kfeet	Distance unit defined in kilofeet.
Miles	Distance unit defined in miles.

Coupling

Strong	For classical, long single-mode fibers
Weak	For polarization-maintained fibers and components. A weak coupling includes three peaks for a Fast Fourier Transform Method (FFT).

Results Screen parameters

Alarms

None	None selected. Selecting this option removes access to the Auto Values and Bit rate info. options (they will disappear from the screen).
Active	To include any survey alarms. The following fields are then enabled.

Auto Values

No	Threshold values are entered manually.
Yes	Threshold values are automatically calculated and adjusted in accordance with the selected information from the Bit rate info. table. This option gives access to the lines PMD Delay and PMD Coeff.

Bit rate info.

A table to the right of this option appears when the Bit rate info. is selected. This table lists the available PMD standards that can be used. To make a choice, use the direction arrow keys ◀ and ▶. For further information about PMD standards, refer to the table on page 140.

PMD Delay	Maximum delay before an alarm signal.
PMD Coeff.	Maximum PMD coefficient before an alarm signal.
PMD2 Delay	Maximum second order PMD delay before an alarm signal. (Only appears if Coupling is set on Strong

PMD2 Coeff. Maximum second order PMD coefficient before an alarm signal.

Delay and coefficient values for PMD and PMD2 can be modified with the directions keys or using the **Edit Number** key.

Parameters available in the File Menu are identical to those for other file types (see "File configuration menu" page on 220).

Performing a PMD measurement with a 5073XXX plug-in or OSA-16X / OSA-20X / OSA-30X series module

It is recommended before performing a PMD measurement, at least once a day, to carry out a reference measurement of the broadband source. The fiber under test is connected to the OBS-15, or E81BBS1, or E81BBS2 and Base Unit by test cables.

On the measurement examples below, only the OBS-15 will be described. But it can easily be replaced by the E81BBS1 or E81BBS2.

Performing the reference

To do this, use the following process:

Remote operator

1 Remove the protection cap on the OBS-15 and then connect the connector to the fiber link under test.

2 Press the **ON/OFF** button to switch on the OBS-15 broadband source.

Keep pressure on the **ON/OFF** button until the **> 2s PERM** LED lights up.

The **CW** LED lights up while the green **1550 nm** LED will flash for a few seconds before being steadily lighted.

Local operator

1 Remove the dust cap from the Signal Input optical socket situated on the rear panel of the Base Unit to connect the fiber link you have connected to the OBS-15 via the two jumpers and coupler as shown in the below diagram.

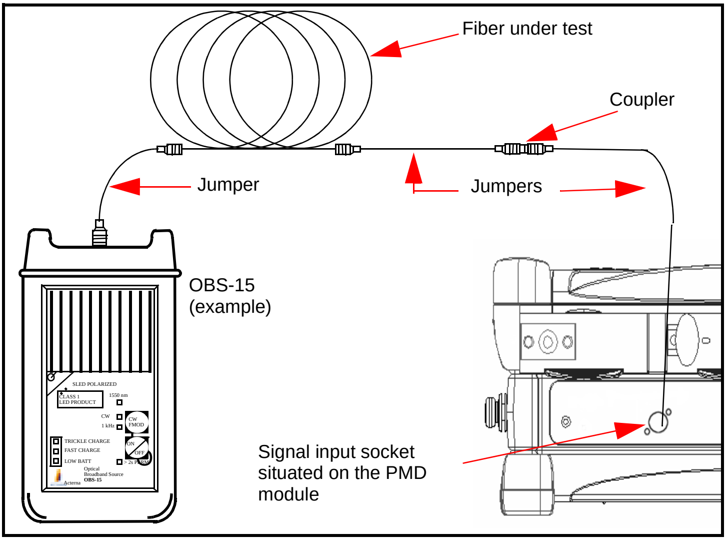


Fig. 37 Reference measurement

2 Select the PMD function in the Instrument Setup menu. To do this, press the **SETUP** button, then select the PMD function, and press the key  .

Fig. 38 Selection of the PMD function (8000 series example)

3 Press the button **RESULTS** to display the auto-calibration status. A bargraph informs of the progression state of the calibration at the bottom of the screen. Wait for the calibration to be fully completed before continuing.

4 Press the button **SETUP** to access to the Base Unit configuration menu for PMD. Use the keys ▲ and ▼. to move the cursor to the different parameters and the keys ◀ and ▶ to modify a value.

5 Check that the option **Make Reference** is set to **Yes** in the configuration menu.

> **NOTE**
>
> When a reference is performed, acquisition parameters are not taken in account, except for those concerning averaging.

6 Press the button **START/STOP** to start the reference of the broadband source. To display the results, press the button **RESULTS**. Once the reference is correct, PMA measurement may take place.

Fig. 39 Example of a correct reference for a broadband source

A bargraph shows if the source power level will allow to perform PMD measurements correctly.

Weak  Strong

If the reference measurement does not provide a correct result, check the following points:

Error message	Possible problem	Possible solution
Acquisition impossible Hit any key to continue	Auto-calibration is not completed	Wait for the calibration to be terminated
Signal level too low ! Check source and con-nections Hit any key to continue	The OBS-15 is not switched on	Press the **ON/OFF** button to switch on the OBS-15, verify if **Make reference** is still set to **Yes**, then repeat step 6
	The OBS-15 battery is too low	Check if the **LOW-BATT** red led is lighted. If yes, then recharge the battery.
	Defective connections	Check that the cables are properly connected, and the notches on the connectors are correctly aligned.

Performing the measurement

When the reference measurement of the broadband source has been completed, the polarizer replaces the coupler.

Use the following procedure to make a measurement:

1 Remove the two protection caps on the OVP-15.

2 Disconnect the coupler and connect the cables to the OVP-15. Either connector on the OVP-15 can be used.

3 Set the OVP-15 polarization angle to 0º (any polarization angle would be acceptable, however it is preferable not to change it).

4 Press the **SETUP** button to access the Base Unit configuration menus.

5 Select the appropriate PMD test setup according to your application as earlier defined in this chapter.

6 Press the **START/STOP** button to see the results within a few seconds.

7 Repeat the PMD measurement for every fiber to be tested (it will have to be connected to the OBS-15).

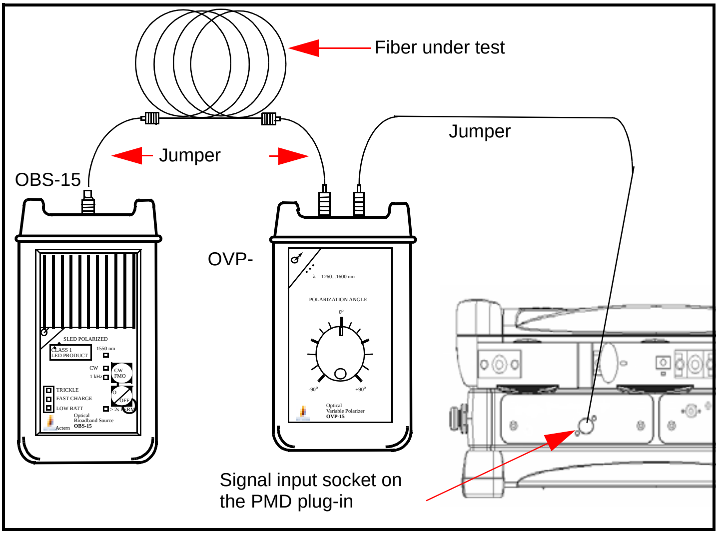


Fig. 40 PMD measurement with an external polarizer

Performing a PMD measurement with a 81XXX plug-in

The 81XXX plug-in is equiped with an internal polarizer which is automatically switched on and off during referencing. The reference is therefore done automatically by the Base Unit.

Remote operator

1 Remove the protection cap on the OBS-15 and then connect the connector to the fiber link under test.

2 Press the **ON/OFF** button to switch on the OBS-15 broadband source.

Keep pressure on the **ON/OFF** button until the «> 2s PERM» LED lights up.

The **CW** LED lights up while the green «1550 nm» LED will flash for a few seconds before being steadily lighted.

Local operator

1. Remove the dust cap from the Signal Input optical socket situated on the rear panel of the Base Unit to connect the fiber link you have connected to the OBS-15 as shown in the below diagram.
2. Select the PMD function in the Instrument Setup menu.
3. Press the **SETUP** button to access the Base Unit configuration menus.
4. Select the appropriate PMD test setup according to your application as earlier defined in this chapter.
5. Press the **START/STOP** button to see the results within a few seconds.
6. Repeat the PMD measurement for every fiber to be tested (it will have to be connected to the OBS-15).

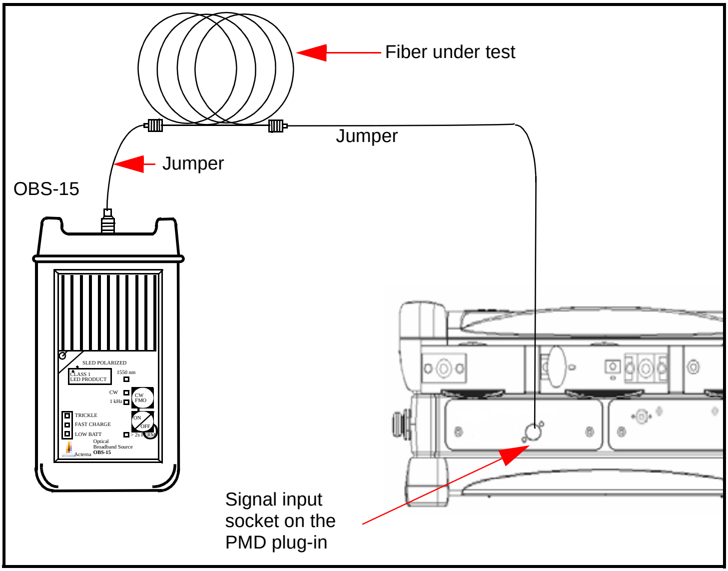


Fig. 41 PMD measurement with a 81XXX plug-in

Display of results

Spectrum/FFT menu key

The key **Spectrum / FFT** enables you to display:

– either the spectrum representing the power (in dBm) according to the frequency (in THz or wavelength in nm according to setup configuration).
– or the FFT curve and PMD information (delay & coefficient) according to the Fast Fourier Transform Method. The FFT trace represents the PMD delay in ps.

Display of PMD results

The PMD results screen presents zones from the top to bottom displaying:

– the file name (if the result is stored in the memory).
– characteristics specific to PMD test: module name, number of acquisitions used for the statistics (Acq), wavelength range (1525-1610), fiber number (N:), fiber length in defined unit, date and time of acquisition.
– the trace (with the scale and the method in the right top corner).
– the results associated with cursors A and/or B (according to their selection).
– a message giving the acquisition in progress status or requesting to make the next step.
– the table of results: PMD delay and coefficient, PMD2 delay and coefficient. This table has only one line if statistics have not been selected when configuring the acquisition in the PMD TEST SETUP menu (see "Mode" page on 126).

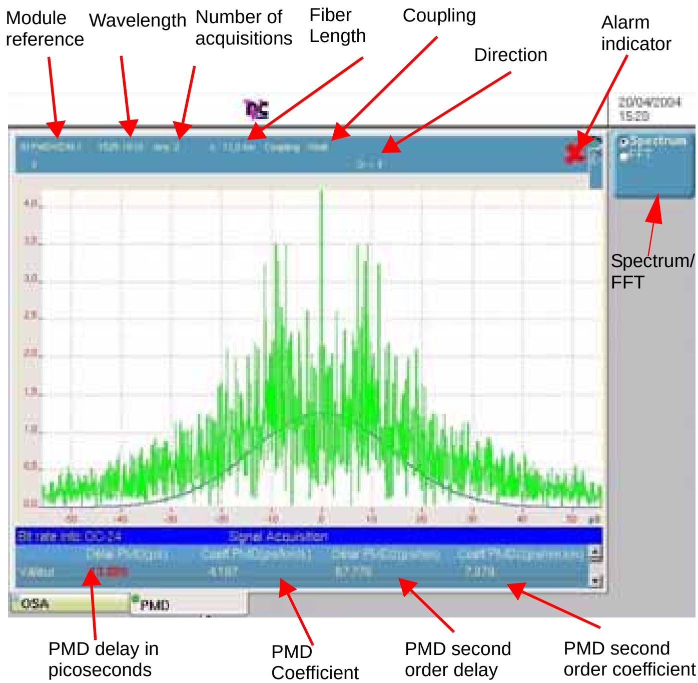


Fig. 42 Example of a result obtained with the FFT method

> **NOTE**
> When several acquisitions are performed, the trace resulting from the last acquisition is displayed.

PMD trace with FFT method

The trace represents the delay distribution trace (in ps).

Cursor (within Spectrum display)

To move the cursor(s) on the trace, press the **Cursor** menu key, then use the direction arrow keys ▲ and ▼ or ◀ and ▶ . The coordinates of each cursor intersection with the trace are indicated underneath the trace:

Zoom (within Spectrum display)

In order to zoom in on the trace, press the **Zoom/Shift** menu key to display **Zoom**, then use the direction arrow keys to zoom in either horizontally or vertically.

The zoom of the display is made around the selected cursor(s).

> **NOTE**
>
> To reset the zoom and see the full trace, press **Full scale**.

> **NOTE**
>
> In **FFT** display mode, data is displayed with an automatically calculated zoom.

Trace shifting (within Spectrum display)

To shift the trace horizontally or vertically, press the **Zoom/Shift** menu key, then use the direction arrow keys to make the required shift.

Statistics results

Statistics can be performed on a series of samples defined by the time between two consecutive samples (Wait period) and the number of samples. The choice of these parameters must be done in the PMD **SETUP** menu (Acquisition mode): see "Acquisition parameters" page on 126.

To display the statistic results press the **RESULTS** button.

Table of results

When the statistics are activated, the results are in a table giving for the four parameters (PMD delay and coefficient, PMD2 delay and coefficient): current value, average value, min value, max. value and standard deviation (Sdev). The statistic results in the table are automatically updated with each acquisition.

Graphics display

When Statistic mode is selected, the button <Spectrum/FFT> becomes <Spectrum/FFT/Drift/Barchart>

This button allows therefore to display alternatively two new windows :

– The trace showing the delay drift during the acquisition time

Fig. 43 Example of drift

– The histogram providing the delay value for each acquisition

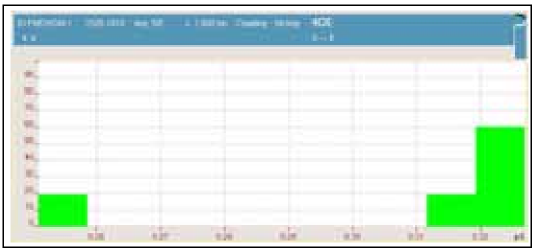


Fig. 44 Example of histogram

Information messages

Under the trace, at the right-hand corner a message indicates the current status of the trace or proposes the step to do next (by clicking on **Stop wait**).

Signal acquisition

This message indicates that an acquisition is in the process of being carried out.

To stop an acquisition, whatever the mode is used, press the **START/STOP** button.

Then, press either the button **SETUP** to go back to the Base Unit configuration menu or press the button **START/STOP** to start a new identical acquisition.

Next measurement

After each acquisition in the **Statistic** mode and when **Long term** has bee set on **Period** or **Manual**, this message requests that you select S**top Wait**. The Base Unit then displays Signal Acquisition. Push the **Start/Stop** button to stop the cycle if necessary.

Ready to make cycle

This message appears after a acquisition cycle is terminated, when you are in statistic mode. Press **START/STOP** to start a new cycle.

Ready to make Measure

The message is displayed after the completion of a Single mode acquisition sample or a Reference measurement. Either, press the **SETUP** button to return to the Base Unit configuration menu or **START/STOP** button to start the same acquisition sample. This message is also displayed in continued mode, if the button **START/STOP** has been used to stop and restart a measurement.

Waiting bargraph

When **Statistic** mode is used and **Long term** is set to **Period**, a bargraph displays on the right of the results, the remaining time before the next acquisition.

File Management

Storing PMD results

If you had entered Auto store, then the results will be saved automatically.
If not, or if you want to store the results under another name, directory etc.:

1. Click on the **FILE** key
2. Select **Setup** with the key **Setup/Explorer**.
3. Modify the parameters you want
4. Click on **Store Trace**

The PMD traces are stored with the extension ".PMD".

Recalling PMD files

Once a PMD file has been stored, recall it using the Explorer:

1 Select **Explorer** with the key **Setup/Explorer**.

2 Using directions keys, select the directory and then the file to open

3 Click on **Load**

4 Click on **View Tace(s)** or **Load Trace + Config.**

The selected file is opened

For further informations on file management, see Chapter 13 “File management”

PMD standards and limits

Table 1 List of the appropriate standards and limits for PMD.

Standards	Description	Limits
ITU-T G.650	Definition and test methods for the relevant parameters of single-mode fibers	PMD method is provided
ITU-T G.652	Characteristics of a single-mode optical fiber cable	PMD Coefficient < 0.5 ps/ square (km) at 1550 nm
ITU-T G.653	Characteristics of a dispersion-shifted single-mode optical fiber cable	PMD Coefficient < 0.5 ps/ square (km) at 1550 nm
ITU-T G.655	Characteristics of a non-zero dispersion-shifted single-mode optical fiber cable	PMD Coefficient < 0.5 ps/ square (km) at 1550 nm
ITU-T G.69 chapter 6.3.2.3	Optical interfaces for single channel STM-64, STM-256 systems and other SDH systems with optical amplifiers	No specified limit. Refer to cable/fiber properties

Limit of the second order coefficient: PMD2 <0.2 ps/nm.km

Some organizations and standards are stating that 10% of the bit rate for the PMD delay can be tolerated for a system without disturbing the network performance by more than 1 dB loss, at 1550 nm, with NRZ coding:

Bit Rate Per Channel	**SDH**	**SONET**	**Equivalent Time-slot**	**PMD Delay Limit**	**PMD Coefficient For 400 km**
55 Mbit/s	—	OC-1	19.3 ns	2 ns	<96
155 Mbit/s	STM-1	OC-3	6.43 ns	640 ps	<32
622 Mbit/s	STM-4	OC-12	1.61 ns	160 ps	<8
1.2 Gbit/s	—	OC-24	803 ps	80 ps	<4
2.5 Gbit/s	STM-16	OC-48	401 ps	40 ps	<2
10 Gbit/s	STM-64	OC-192	100 ps	10 ps	<0.5
40 Gbit/s	STM-256	OC-768	25.12 ps	2.5 ps	<0.125

Abacus for a typical system

You will find below the abacus for a typical system, giving the maximum distance as a function of PMD coefficient, for given transmission bit rates.

This abacus is provided with the following assumptions:

- the PMD is considered to be Maxwelliam,
- NRZ coding is used,
- 1550 nm lasers are used,
- a maximum power penalty of 1 dB is acceptable,
- a BER is typically between 10^{-9} and 10^{-12}.

With this in mind, the following formula could be applied (L is the distance in km, B the bit rate in Gbit/s, PMD the PMD value in ps/km$^{1/2}$):

$$L\ (km) = 10^4 \times 1/(B \times PMD)$$

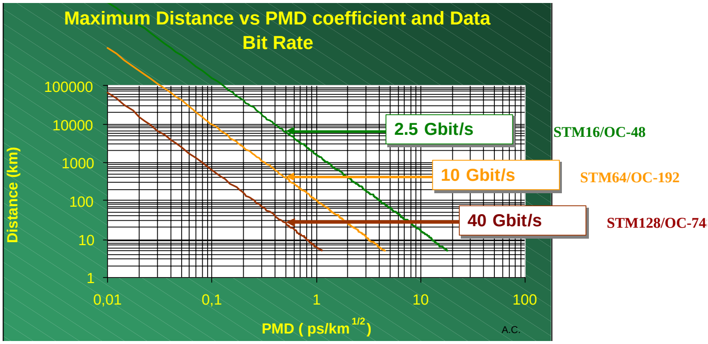


Fig. 45 Abacus for a typical system (maximum distance as a function of PMD coefficient, for standard bit rates)

Attenuation profile

8

This chapter describes the different steps in carrying out a Attenuation Profile (AP) measurement with a Base Unit equipped with a 81WDMPMD (full-band plug-in).

The topics discussed in this chapter are as follows:

It is assumed that you are familiar with the operation of the Base Unit and the Optical Broadband Source you are using.

Recommended equipment

To perform a AP measurement, the following equipment is recommended:

– Base Unit with a plug-in or module as referenced above, and associated optical connector.
– OBS-15[1], E81BBS1, E81BBS2 or any other Optical Broadband Source with associated optical connectors.
– Fiber scope with associated optical connectors.
– Cleaning kit.
– Two jumpers with associated optical connectors.
– One coupler.
– Communication tool (either GSM or telephone, or optical talk set).

AP Setup menu

After connecting the fiber to be tested and all the equipment is switched on and ready for use, you will then need to set up the Base Unit to perform an AP measurement.

To access the Attenuation Profile setup menu, press the **SETUP** button on the Base Unit. The different measurement parameters are displayed.

To modify a parameter, use the direction arrow keys ▲ et ▼. The possible options will then be displayed. To change an option, use the direction arrow keys ◀ and ▶ to make a choice.

1.The OBS-15 and E81BBS Optical Broadband Source covers S+C+L bands. The E81BBS2 covers the OESCL bands.

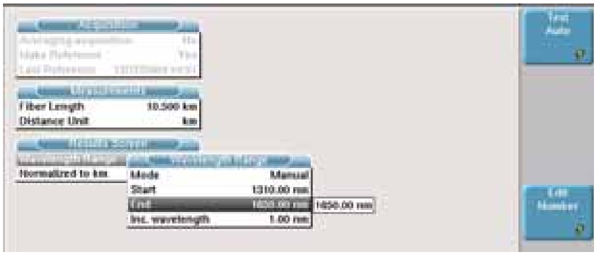


Fig. 46 Configuration menu for AP test

The different parameters proposed are described below.
You may:

- either choose the default values by pressing the Test Auto key
- either define your own configuration.

Test Auto configuration

Setup Menu

Acquisition:

- Averaging acquisition: No

Results Screen:

- Wavelength range: full
- Normalized to km: No

File menu

- File naming: Auto
- Auto store: Yes
- Fiber Nb Increment: Yes

In **standard** mode, you can set the parameters below.

Acquisition parameters

> **NOTE**
>
> When the composite power of the input signal is higher than 20 dBm, a warning is displayed and the signal is cut off

Acquisition band

- OESCL — Full band will be considered for acquisition.
- SCL — Only S, C and L bands shall be considered for acquisition.

Averaging acquisition

Only considered for measurement, not for reference, it is used to improve the dynamic range of the unit:

- No — No average of the acquisition sample to be performed.
- Low — Low averaging (4 samples).
- Medium — Medium averaging (16 samples).
- High — High averaging (32 samples).

> **NOTE**
>
> An increase of the averaging can improve the dynamic range to up to 5 dB.

Make Reference

- Yes: — Option to select if you wish to perform a reference before performing the AP measurement.
- No: — Default option. The instrument automatically sets back to this option after the reference has been performed.

The date of the last reference is displayed below this field.

Measurements

Fiber length

The fiber length must be set to provide the AP result. Use the numeric keypad or the direction keys to modify the fiber length (Min = 0.100 km / Max = 300 km).

Unit

- Km — Distance unit defined in kilometers.

- – Kfeet Distance unit defined in kilofeet.
- – Miles Distance unit defined in miles.

Results Screen

Wavelength Range

- – Full Displays results along the full band
- – S+C+L Band Displays results along S, C + L bands.
- – C+L Band Displays results along C + L bands.
- – Manual Displays results between 2 user defined wavelengths. The user must then select the wavelength to <start> with and the wavelength to <end> with.

Modify **Inc.Wavelength** if necessary in the mode edition menu. This parameter is used to define how many points shall be considered in the table and spectrum analysis.

Normalized to km

- – No The AP result shall be provided in dB.
- – Yes The AP result shall be provided id dB/km (result calculated according to fiber length and total attenuation).

AP Measurement

On the measurement examples below, only the OBS-15 will be described. However, it can be easily replaced by E81BBS1 and E81BBS2.

1 Select the **AP** function in the Instrument **SYSTEM** menu. To do this, press the **SYSTEM** button, then select the **AP** function, and press the key  .

Fig. 47 Selection of the AP function (8000 series example)

2. Press the button **RESULTS** to display the auto-calibration status. A bargraph **tuning** informs of the progression state of the calibration at the bottom of the screen. Wait for the calibration to be fully completed before continuing.
3. Press the button **SETUP** to access to the Base Unit configuration menu for Spectrum analysis. Use the keys ▲ and ▼ to move the cursor to the different parameters and the keys ◀ and ▶ to modify a value.

Performing the reference

It is recommended before performing an AP measurement, at least once a day, to carry out a reference measurement of the broadband source.

To make a reference, connect your OBS-15 or BBS to your Base Unit just like shown on figure below.

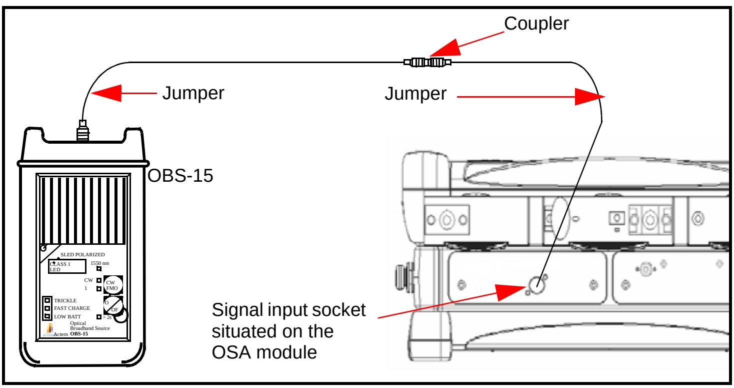


Fig. 48 Reference measurement

1 Check that the option **Make Reference** is set to **Yes** in the configuration menu.

> **NOTE**
>
> When a reference is performed, acquisition parameters are not taken in account.

2 Press the button **START/STOP** to start the reference of the broadband source. To display the results, press the button **RESULTS**. Once the reference is correct, AP measurement may take place.

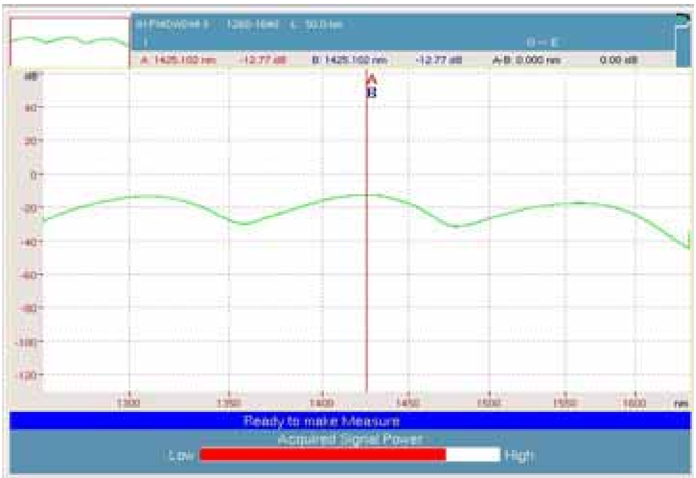


Fig. 49 Example of a correct reference for a broadband source

A bargraph shows if the source power level will allow to perform AP measurements correctly.

Weak  Strong

If the reference measurement does not provide a correct result, check the following points:

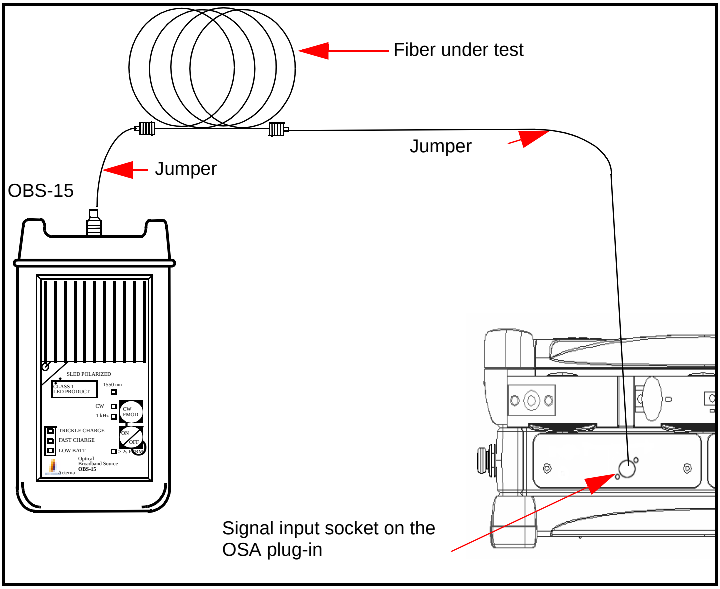
Error message	Possible problem	Possible solution
Acquisition impossible Hit any key to continue	Auto-calibration is not completed	Wait for the calibration to be terminated

Error message	Possible problem	Possible solution
Signal level too low ! Check source and connections Hit any key to continue	The OBS-15 (or other source) is not switched on	Press the **ON/OFF** button to switch on the source, verify if <Make reference> is still set to <Yes>, then repeat step 2
	The OBS-15 (or other source) battery is too low	Check if the **LOW-BATT** red led is lighted. If yes, then recharge the battery.
	Defective connections	Check that the cables are properly connected, and the notches on the connectors are correctly aligned.

Performing a AP measurement

When the reference measurement of the broadband source has been completed, use the following procedure to make a measurement:

1. Disconnect the coupler and connect each end to each extremity of the fiber.
2. Press the **SETUP** button to access the Base Unit configuration menu.
3. Select the appropriate AP test setup according to your application as earlier defined in "AP Setup menu" on page 144.
4. Press the **START/STOP** button to see the results within a few seconds.
5. Repeat the AP measurement for every fiber to be tested (it will have to be connected to the OBS-15).



NOTE

You may modify the fiber length at any time without performing a measurement again. The AP result pro kilometer will be recalculated automatically.

Display of AP results

The AP results screen presents different zones (see: "Example of a AP result (Showing profile)" on page 152)

Trace display

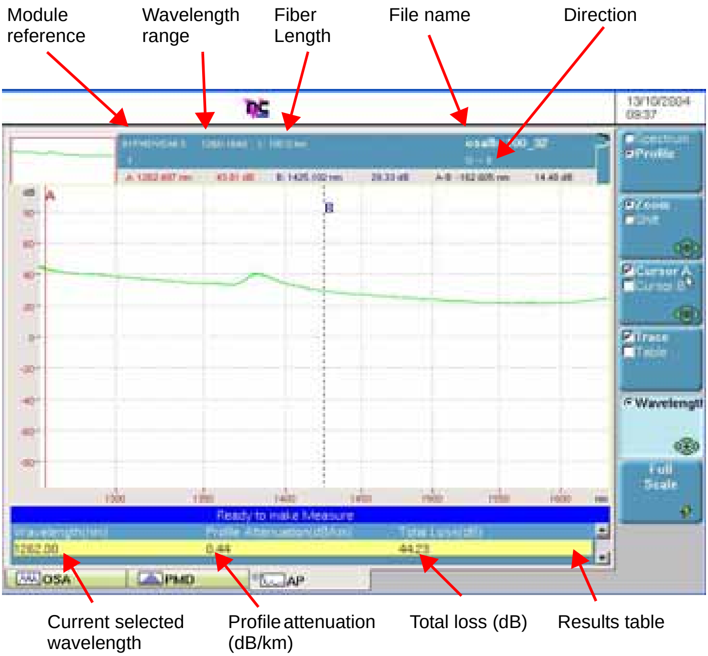


Fig. 50 Example of a AP result (Showing profile)

NOTE
When several acquisitions are performed, the trace resulting from the last acquisition is displayed.

Spectrum/Profile

For a reference measurement, only the spectrum is available.

For a AP measurement, two different graphs may be visualized.

The first graph shows the final spectrum (see figure "Example of a spectrum view after a measurement" on page 153).

Fig. 51 Example of a spectrum view after a measurement

The second graph, the attenuation profile, shows the difference between the final spectrum and the reference spectrum of the broadband source (see figure "Example of a AP result (Showing profile)" on page 152).

You may switch from the «Profile» view to the final «Spectrum» view using the button **Spectrum/Profile.**

NOTE

The **Trace - Table** and **Wavelength** functions are available exclusively with the Profile mode.

Zoom

In order to zoom in on the trace, press the **Zoom/Shift** menu key to display **Zoom**, then use the direction arrow keys to zoom in either horizontally or vertically.

The zoom of the display is made around the selected cursor(s).

NOTE

To reset the zoom and see the full trace, press **Full scale**.

Trace shifting

To shift the trace horizontally or vertically, press the **Zoom/Shift** menu key to display **Shift**, then use the direction arrow keys to make the required shift.

Cursor

To move the cursor(s) on the trace, press the **Cursor** menu key, then use the direction arrow keys ▲ and ▼ or ◀ and ▶ . The coordinates of each cursor intersection with the trace are indicated underneath the trace.

Wavelength

To move the cursor from one wavelength to the next one, press the **Wavelength** menu key and use the arrow keys ▲ and ▼ or ◀ and ▶. The cursor will move both on the trace and in the table (if the trace and/ or the results table is displayed).

Results table

Trace/Table

Enables the display on the trace and/or the results table.

8 lines of the results can be displayed below the trace, or 20 lines with no trace.

The results table shows for each wavelength (calculated using the wavelength range and the incrementation parameter as seen in "Wavelength Range" on page 147), the attenuation profile in dB/km and the total loss in dB.

File Management

Storing Attenuation Profile measurements

If you had entered Auto store, then the results will be saved automatically.
If not, or if you want to store the results under another name, directory etc.:

1 Click on the **FILE** key

2 Select **Setup** with the key **Setup/Explorer**.

3 Modify the parameters you want

4 Click on **Store Trace**

The Attenuation Profile traces are stored with the extension ".AP".

Recalling AP files

Once an AP file has been stored, recall it using the Explorer:

1 Select **Explorer** with the key **Setup/Explorer**.

2 Using directions keys, select the directory and then the file to open

3 Click on **Load**

4 Click on **View Tace(s)** or **Load Trace + Config.**

The selected file is opened

For further informations on file management, see Chapter 13 “File management”

Measurement of chromatic dispersion

9

The 5083CD module (+ the 50otdrExt extension) makes available three functions:

– CD analyzer,
– reflectometer,
– laser source.

The OTDR function is described in "Reflectometry measurements" on page 43.

The source function is described in the chapter "Source function" on page 179.

The chromatic dispersion analyzer function is described in all the rest of this chapter. The topics discussed in this chapter are as follows:

Configuring the instrument

After connecting the fiber under test to the optical connector of the 5083CD module of the Base Unit, you must select the CD function. To do this, press the **SYSTEM** button. If the instrument is equipped with more than one plug-in, or if the sole plug-in provides more than one function:

– use the direction keys ◀ and ▶, to select the function: the icon under the cursor is framed in green.

– select the function by pressing ↵: the icon turns orange-yellow.

Configuring the CD test

To configure a chromatic dispersion measurement on a fiber, press the SETUP button. The different measurement parameters will be displayed.

You have two choices: press the **Test Auto** to obtain the default configuration, or define your own configuration.

Parameters chosen by automatic configuration:

Laser:	All
Mode:	Auto
Analysis window	Auto (automatically positionned on the end of fiber)
Time of measurement:	00:25
Reference wavelength:	1550 nm
Index:	1.465
Measurement zone:	link
Approximation formula:	Sellmeier 5T
Type of fiber:	Standard
1st analysis window:	Dispersion
Lower wavelength:	1255.0 nm
Upper wavelength:	1650.0 nm
Inc. wavelength :	5 nm
Standardized to 1km :	Yes
Unit	km

To define your own configuration, choose the parameter to be modified, using the direction keys, then choose the option for this parameter with the keys and .

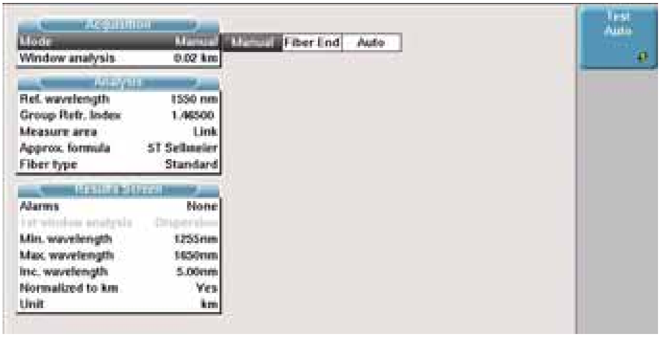


Fig. 52 Configuration of CD test

The configuration parameters of the CD test are described below.

Acquisition parameters

Laser

Choose to carry out the acquisition :

– either on one of the 4 wavelengths proposed: 1310, 1480, 1550 or 1625 nm

– or on all the wavelengths (All).

Mode

Choose the mode of acquisition:

Manual :	Acquisition carried out on an analysis window of width 500 m positioned manually in the end of fiber zone or on a Fresnel (its position must be defined by the following “Analysis window” parameter).
End of fiber:	End of fiber detected by a reflectometry measurement.
Auto:	After automatic detection of the end of the fiber, a CD measurement is taken on all four wavelengths.

Analysis window

In manual mode, enter the distance of the reflective event to be analyzed (Fresnel), corresponding, for example, to the end of the fiber. The parametrization value will correspond to the center of the analysis window.

Measurement time

Choose the duration of acquisition between 25 seconds and 10 minutes.

If the acquisition is performed on a single wavelength, this is the acquisition time for that wavelength.

If the acquisition is performed on all 4 wavelengths, it is the total acquisition time for all the wavelengths, bearing in mind that:

– 1/5 of this time is dedicated to acquisitions on wavelengths 1480, 1550, 1625 nm,
– 2/5 of this timed is dedicated to acquisition on 1310 nm, as this demands a higher number of averagings.

If the acquisition is done in auto mode, the time shown does not take into account the time of detection of fiber ends (30 seconds)

Parameters of analysis

Ref. wavelength

Choose one of the 4 wavelengths: the result of the measurement for this wavelength will be the reference for calculation of delays obtained for the other wavelengths.

Refractive index

Choose the group index N of the fiber from values lying between 1.30000 and 1.70000.

NOTE

This index value is unique, and is not attached to a wavelength. It is used for all acquisitions carried out on the CD tab and is saved with the trace.

NOTE

It is advisable to use the index at 1550 nm, to obtain a correct end of fiber measurement.

Measurement zone

Select the method of measurement of chromatic dispersion:

Link	Measurement of the whole link from one end.
Section	Measure one section from an extremity, making two acquisitions on each extremity of the section See "Measurement of CD on a section" on page 174.

Approximation formula

Select the delay approximation formula to be used for generation of the dispersion and slope curves:

Quadratic	$A+B\lambda+C\lambda^2$. Recommended for G.653 fibers, in the 1550 nm zone.
Sellmeier 3-term	$A+B\lambda^2+C\lambda^{-2}$. Recommended for G.652 fibers in the 1310 nm zone.
Sellmeier 5-term	$A+B\lambda^2+C\lambda^{-2}+D\lambda^4+E\lambda^{-4}$. Recommended in all other cases, including non-homogeneous fibers.

(see "Most suitable method of approximation according to trace zone" on page 15).

Fiber Type

Choose the fiber type you want to measure: Standard / Special.

Select **Special** for a link having a fiber section with shifted dispersion.

For the other cases, select **Standard**.

Results Screen parameters

Alarms

None	None selected. Selecting this option removes access to the Auto Values and Bit rate info. options (they will disappear from the screen).
Active	To include any survey alarms. The following fields are then enabled.

Auto Values: Yes

Threshold values and analysis band are automatically calculated and adjusted in accordance with the selected information from the Bit rate info. table.

Bit rate info.	A table to the right of this option appears when **Auto Values** is set to **Yes**. This table lists the available transport rates that can be used. To make a choice, use the direction arrow keys ◀ et ▶.

Auto values: No

Threshold values are entered manually: select the analysis band and the max dispersion threshold.

Analysis Band	This option appears when **Auto Values** is set to **No**. Select **1550 nm** or **C+L band**. The max dispersion threshold will be considered only on that channel or band.
Disp. Max (ps/nm)	This option appears when **Auto Values** is set to **No**. Select here the max dispersion threshold (from <200 to < 90000 ps/nm).

NOTE

Max. dispersion threshold is always considered on non normalized dispersion values.

The results are given in the form of curves (delay, dispersion, slope) and a table of results (of which 8 lines are displayed if the Table function is selected).

1st analysis window

This parameter can be change exclusively if Auto Mode has been selected in the acquisition parameters/

Choose the curve which will by displayed automatically at the end of the acquisition:

Markers:	reflectometry curves with markers
Dispersion:	dispersion curve

Lower wavelength Lower limit of the wavelength displayed on the curve and in the table:

- from 1255.0 nm to 1640.0 nm

Upper wavelength Upper limit of the wavelength displayed on the curve and in the table:

- from 1265.0 nm to 1650.0 nm

Inc. wavelength Choose wavelength difference between two results memorized in the table.

- from 0.10 to 50 nm
- the number of results memorized depends on the limit values and the value of the increment chosen:
  - max. 512 results.

Standardized to 1 km

Yes	The dispersion value obtained is standardized to 1 km (that is to say, divided by the length of the fiber expressed in km).

Unit Select the unit to be used: km / kfeet / miles.

Making a chromatic dispersion measurement

Measurement process

This measurement is made in 3 stages:

1 Detection of end of fiber by a reflectometry measurement. This stage is indispensable if the length of the fiber is not known.

2 Placing of markers on the End of fiber event: a second reflectometry measurement in the end of fiber zone is made for the 4 wavelengths (1310, 1480, 1550, 1625 nm).

The result is 4 Fresnels on which the markers are placed. One of the Fresnels having been chosen as the reference, the delay or advance of the others is measured with respect to this.

3 Calculation of dispersion on the basis of the position of the markers (see "Method of CD measurement used by the Base Unit" on page 12).

Conditions of measurement

> To carry out a measurement of chromatic dispersion on an optical link, using the OTDR method of the Base Unit, it is necessary to have a reflective element such as a connector at the end of the fiber.

If the end of fiber is detected, but no reflective event is seen during the phase of positioning of the markers, then a 0 dB termination connector should be placed at the end of the fiber (this connector is supplied as an accessory with the CD module). It increases the end of fiber Fresnel peak amplitude and thus enables the measurement. The limit of automatic detection is about 24 dB for the attenuation of the link (120 km at 0.2 dB/km at 1550 nm). In manual mode, it is about 30 dB.

Measurements of chromatic dispersion are generally made with 4 markers at 1310, 1480, 1550 and 1625 nm. However, if only three markers can be positioned, the measurement can still be made, though with reduced accuracy. In this case, the message “Measurement 3 lambdas” is displayed.

To optimize the measurements, it is advisable not to place the markers on saturated Fresnels . If this happens, a message appears. It is then advisable to add an on-line attenuator.

CD acquisition mode

The measurement of chromatic dispersion can use two modes of acquisition: automatic and manual.

Automatic acquisition mode

To make a CD measurement quickly, the automatic mode of acquisition is the easiest. It enables the Base Unit to be automatically configured with the optimum parameters of acquisition for the link under test. The 3 stages of the measurement described above are then carried out automatically.

To start an automatic acquisition:

– in the Configuration CD test menu, choose **Mode = Auto**.
– press the **START/STOP** button.

Manual acquisition mode

The user can obtain the results step by step by using one of the following two methods:

End of fiber detection mode

This mode must be used if the end of fiber has not been correctly detected or if the user wants to test part of the link. It measures the length of the fiber before carrying out the CD measurement. To select this mode:

– In the Configuration CD test menu, choose **Mode = End of Fiber**,
– Press the **START/STOP** button. The Base Unit then automatically displays the result screen and the test progress bar.
– A the end of the acquisition, on the OTDR trace, the cursor automatically positions itself on the end of fiber.
– If you consider that the marker is correctly placed on the end of fiber, press the **Start CD Measurement** key to start the CD measurement.
– If you consider that the marker is not correctly placed on the end of fiber (or the event to be analyzed), adjust its position and then press **Change Window** to memorize this position. Press the **Start Measurement** key to start the CD measurement.

Manual mode

This mode must be used if the acquisition does not allow the placing of markers on one or more of the four OTDR traces, due to insufficient dynamic. To select it, in the Configuration CD test menu:

– choose **Mode = Manual**,
– augment the acquisition time to enable correct detection of the end of the fiber or the reflective event to be analyzed.
– press the **START/STOP** button to start the CD measurement

NOTE

If the reflective events are drowned in noise, it is advisable to use termination connectors. See "Typical specifications of CD module" on page 262.

End of acquisition

After an acquisition on the 4 wavelengths (or after recall of CD results memorized), the result screen displays the traces acquired:

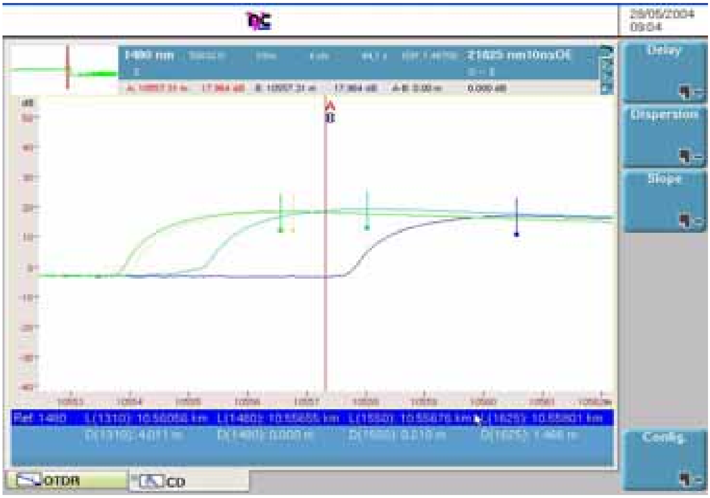


Fig. 53 Traces acquired

Choice of CD result

The **Delay**, **Dispersion** and **Slope** keys give access to the corresponding results, which depend on the zone of measurement, the formula of approximation and the upper wavelength and lower wavelength selected in the Configuration CD TEST menu. See "Delay, dispersion and slope results" on page 170.

Return to this chosen screen

To return to the choice of CD result to be displayed, press the **Exit** key.

Configuration

To operate on these traces (positioning markers, zoom, shift, etc.) press the **Config.** key: see "Placing of markers" on page 168.

Information always displayed

Whatever the mode of acquisition chosen, the following information is always displayed on the result screen:

– Wavelength

- Name of module
- Pulse width
- Resolution
- Acquisition time
- Refractive index
- Name of file (if stored)
- Fiber number
- Direction of propagation
- The information associated with cursors A and B: the A and B horizontal and vertical values, the A-B horizontal and vertical difference, as an absolute value.
- The difference value in dB expressed per kilometre.
- The alarm indicator  or  if **Alarms** is active.

Detection of end of fiber

This mode must be used if the end of fiber has not been correctly detected in auto mode (see "End of fiber detection mode" on page 165).

The screen obtained after the acquisition (or after pressing the **RESULTS** button), displays the information seen in the paragraph "Information always displayed" on page 166, together with:

- the OTDR detection trace
- a zone at the bottom of the screen giving the distance of the end of fiber and the position of the center of the future analysis window.
- the OTDR detection mini-trace to the left of the bar

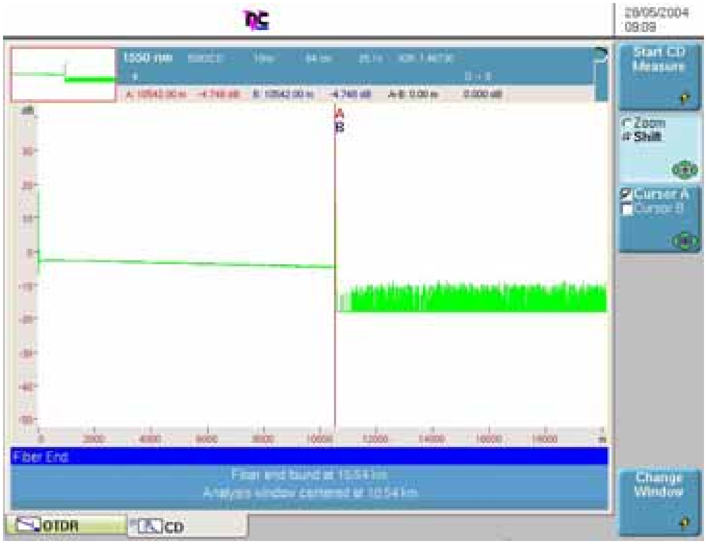


Fig. 54 Detection of end of fiber

Functions available

<Start CD measurementTo start the CD measurement.

<Cursor A/Cursor B> To displace cursor A and/or B: use the Cursor key (**Cursor A/Cursor B**) to select the cursor or cursors, then use the keys ◀ and ▶.

<Zoom/Shift> To shift the trace horizontally or vertically: press this key to display **Shift**, then use the keys ◀ and ▶ until the desired shift is attained.

<Change window> You can change the position of the analysis window, centered on the cursor, in which a Fresnel peak is present (due to a connector, for example). To do this, position the cursor, then press the **Change window** key to confirm your choice. The message “Analysis window centered at x.xx km” is updated.

Placing of markers

After acquisition on the 4 wavelengths, if the markers have not been automatically placed on the basis of the result screen, press the **Config.** key to position them manually.

Fig. 55 Placing markers

Information displayed for the markers

The configuration screen of the markers displays the general information (see "Information always displayed" on page 166) together with the information specific to the positioning of the markers:

- The OTDR traces displayed in a window and showing markers
- The distance with respect to the origin of each marker for each trace.
- The difference of each marker from the reference marker.
- The OTDR mini-trace to the left of the bar.
- Specific keys with which the markers can be modified.

To position a marker:

- Select the trace on which you wish to position the marker by pressing the **Select Lambda** key repeatedly until its wavelength is displayed in the bar.
- To position the marker automatically at the summit of the reflective event of the active trace, press the key **Auto Marker**.
- To position the marker manually, place the active cursor at the desired position, then press **Manual Marker**.

Functions available

<Lambda>	Activates one of the 4 traces : the wavelength of the active trace is shown at the top left of the screen.
<Zoom/Shift>	To shift the trace horizontally or vertically, press this key to show <Shift>, then use the keys ◀ and ▶ until the desired shift is obtained.
<Cursor A/Cursor B>	To displace cursor A and/or B press the key to show <Cursor A/Cursor B>), then use the keys ◀ and ▶. The wavelengths on which the cursors are positioned are displayed in the bar of the trace, together with the difference in wavelength and power between the cursors.
<Auto Marker>	Places the marker automatically at the peak of the reflective event of the active trace.
<Manual Marker>	Places the marker on the active cursor. If cursors A and B are both selected, the marker will not be moved. If the cursor is close to the marker, the latter will be deleted.
<Set Ref.>:	This key is grayed unless the zone of measurement chosen in the configuration menu is “Section”. See "Measurement of CD on a section" on page 174.
<Exit>	Returns to the preceding result selection screen (Delay, Dispersion, Slope).

Delay, dispersion and slope results

These results depend on the choices made in the configuration menu: upper and lower wavelengths, incrementation step and standardization to 1 km.

Information displayed for the results

The result screen obtained after pressing one of the keys <Delay>, <Dispersion> or <Slope> displays the same standard information (see "Information always displayed" on page 166), together with the following information:

– The curve requested (delay, dispersion or slope) is displayed

- A line of characteristics specific to the measurement of slope, delay and dispersion is displayed above the trace:
  - L0: Dispersion wavelength zero
  - So: Slope associated with L0
  - Lref: Length of the fiber at the reference wavelength
  - Wref : Reference wavelength
  - Fit: Formula of approximation used
- A line of the results table. By selecting **Table** with the **Trace/Table** key, 8 lines of the of results can be displayed below the trace, or 20 lines with no trace.

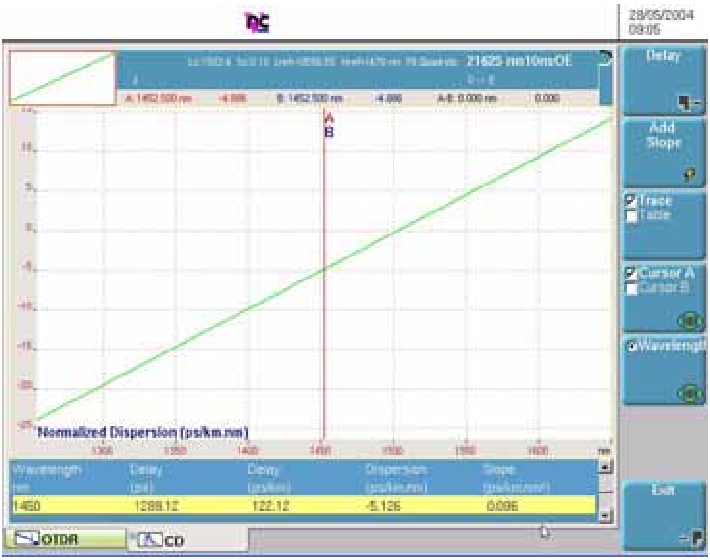


Fig. 56 Measurement of dispersion

Choice of curve

- If the delay curve was requested, it will be possible to change over to the dispersion curve and add the slope curve to it (Click on **Add Slope**).
- If the dispersion curve was requested, it will be possible to add the slope curve and change over to the delay curve.
- If the slope curve was requested, it will be possible to add the dispersion curve and change over to the delay curve.

When a curve is added, the screen is divided so that both curves can be displayed.

> **NOTE**
>
> If the table is displayed first, it will disappear when the curve is added.
>
> If it is desired to display or redisplay the table after addition of the slope curve, the latter must first be erased by clicking on **Exit** or **Delete Slope**.

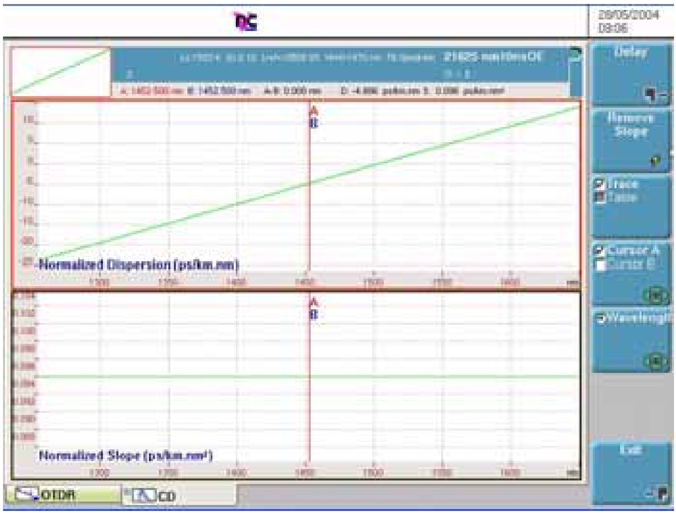


Fig. 57 Example of display of two curves

Functions available

<Add Slope> (or <Add Disp.> depending on the first trace displayed)
The screen is divided into two parts for the simultaneous display of the dispersion and slope curves.

<Delete Slope> (or <Delete Disp.>)
Returns to the display of the dispersion (or the slope) alone.

<Trace/Table> Displays the trace alone, the table alone or both, depending on the boxes marked. When both are requested, the size of the trace is reduced so as to display 8 lines of results in the table.

<Cursor A/Cursor B> The cursor or cursors selected are displaced along the trace by means of the ◀ and ▶ keys. The displacement step is as defined in the configuration menu of the CD test (Results /Inc. Wavelength). The result corresponding to the position of the cursor on the trace is highlighted in the table.

<Lambda> When the function is activated, the ◀ and ▶ keys cause the table of results (which may contain up to 512 lines) to scroll across the screen. The active cursor then follows this displacement on the trace.

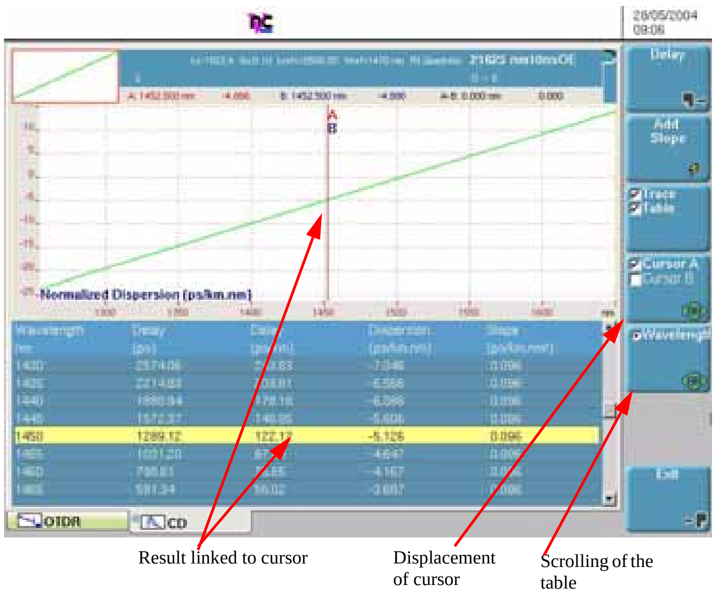


Fig. 58 Example of display of the table

Alarms

Results lying outside the thresholds selected by the user in the **Alarm** field (Max dispersion), will be displayed in red in the table, and the icon  will appear at the top right of the screen. If all the results lie within the thresholds (no result is in red), the icon becomes .

Measurement of CD on a section

The CD method, provided by the Base Unit, allows to measure the CD not only of the entire link, but also of sections of the fiber. This feature may be useful if 2 different types of fibers are used on one link.

To make such a measurement, the section must be separated by specific events, such as reflective events (or Fresnel) like connectors.

> ⚠ The different measurements must be performed with the same module.

Acquiring a trace for CD measurement on a section

The process to measure the CD results of a section located between event X and Y, is as follows:

– Select in the **SETUP** menu: **Measure area = Section.**
– Select for the window analysis, the distance to the X event.
– Perform a CD measurement
– Save the trace (**FILE** key, see “File Management” on page 176)
– Select for the window analysis, the distance to the Y event (**SETUP** menu).
– Perform a new CD measurement.
– Load the trace having the CD results up to the X event by pressing **Load** followed by **Load Measure Ref.** in the **File** menu.

You may now see the CD results for the specific section.

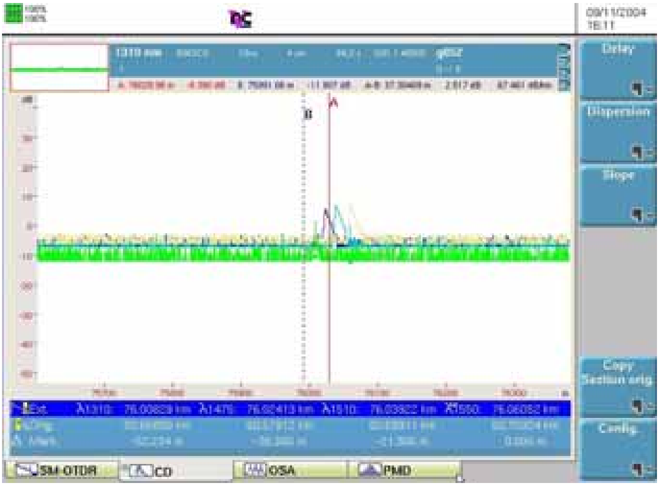


Fig. 59 CD measurement on a section

CD measurement on a section using stored traces

The process to measure the CD results of a section located between 2 events X and Y, is as follows:

- Load the trace containing the CD results up to the Y event, by pressing **Load** followed by **View Trace** in the file menu.
- Select in the CD **SETUP** menu: **Measure area = Section**
- Load the trace having the CD results up to the X event by pressing **Load** followed by **Load Measure Ref.** in the **File** menu.

When storing the trace, all those parameters will be taken into account and stored.

If the link is too long to make a CD measurement from one single extremity, a bidirectional measurement can be done.

To do so, the fibre must have specific elements (for example, reflective events or Fresnels) such as the connectors, measurable from the link extremities.

Measure uses two acquisitions, which must be realised with the same CD module.

File Management

Storing CD measurements

If you had entered Auto store, then the results will be saved automatically.
If not, or if you want to store the results under another name, directory etc.:

1. Click on the **FILE** key
2. Select **Setup** with the key **Setup/Explorer**.
3. Modify the parameters you want
4. Click on **Store Trace**

The Chromatic Dispersion traces are stored with the extension ".CD".

Recalling CD files

Once a CD file has been stored, recall it using the Explorer:

1. Select **Explorer** with the key **Setup/Explorer**.
2. Using directions keys, select the directory and then the file to open
3. Click on **Load**
4. Click on **View Tace(s)** or **Load Trace + Config.**

   The selected file is opened

For further informations on file management, see Chapter 13 "File management"

CD standards and limits

Measurements of chromatic dispersion are only necessary in the following cases:

- Adaptation of of existing networks to transmission speeds of 10 Gbits/s or more.
- Installation of new fiber networks for transmission speeds of 10 Gbits/s or more.
- Qualification of fibers and components by manufacturers.

The conditions required for measurements of CD are invariably linked to transmission speeds per channel and at the corresponding distance. Chromatic dispersion is also an important parameter for fibers with offset dispersion (ITU-T G.653), as the zero dispersion wavelength must not be in the range of the channels (this would generate 4 mixed waves, and would oblige consequent irregular spacing between channels).

Standards relating to chromatic dispersion

Standard	Description
ITU-T G.650	Definition and test method for parameters appropriate to single-mode fibers
ITU-T G.652	Characteristics of a cable of single-mode optical fibers
ITU-T G.653	Characteristics of a cable of single-mode optical fibers with offset dispersion
ITU-T G.655	Characteristics of a cable of single-mode optical fibers with non-zero offset dispersion
IEC 60793-1-1	Optical fibers - Part-1: generic specification - General
IEC 60793-1-42	Optical fibers - Part 1-42: Method of measurement and test of procedures - Chromatic dispersion
IEC 61744	Calibration of testers of chromatic dispersion of optical fibers
TIA/EIA FOTP-168	Measurement of chromatic dispersion of multimode optical fibers with graded index and single mode, by measurement of group spectral delay in the domain of time
TIA/EIA FOTP-169	Measurement of chromatic dispersion of single-mode optical fibers by the phase shift method
TIA/EIA FOTP-175	Measurement of chromatic dispersion of single-mode optical fibers by the differential phase shift method
GR-761-CORE	Generic criterions for testers of chromatic dispersion
GR-2854-CORE	Generic conditions Compensators of chromatic dispersion of optical fibers
GR-253-CORE	Transport system on synchronous optical networks (SONET)

Calculation charts available

A typical calculation chart can be used to give the limit delay as a function of the speed of transmission per channel. The Telcordia GR-253-CORE standard “Synchronous Optical Network (SONET) transport system”, indicates that the delay of propagation between different wavelengths, due to chromatic dispersion, must not exceed 0.306 times the time interval NRZ.

Transmission speed per channel	SDH	SONET	Equivalent time slot	Max; permissible delay at 1550 nm
51 Mbit/s	-	OC-1	19.3 ns	5.9 ns
155 Mbit/s	STM-1	OC-3	6.43 ns	1.97 ns
622 Mbit/s	STM-4	OC-12	1.61 ns	492 ps
1.2 Gbit/s	-	OC-24	803 ps	246 ps
2.5 Gbit/s	STM-16	OC-48	401 ps	123 ps
10 Gbit/s	STM-64	OC-192	100 ps	30 ps
40 Gbit/s	STM-256	OC-768	25.12 ps	7.8 ps

A similar calculation chart is also provided by the ITU standards. It gives the maximum distances for different transmission speeds and types of fiber, at about 1550 nm:

Transmission speed per channel (Gbit/s)	SDH	SONET	G.652 SSMF	G.655 NZ-DSF
2.5 Gbit/s	STM-16	OC-48	640 km	4400 km
10 Gbit/s	STM-64	OC-192	50-100 km	300-500 km
40 Gbit/s	STM-256	OC-768	5 km	20-30 km

Other calculation charts give the maximum cumulative chromatic dispersion for an attenuation of 1 dB, as a function of the speed R, given in Gbit/s. This calculation chart corresponds approximately to the formula: D < 105/R2.

Transmission speed	SDH	SONET	Total permissible coefficient of dispersion at 1550 nm for a given link (not standardized to 1 km)
2.5 Gbit/s	STM-16	OC-48	12000 to 16000 ps/nm
10 Gbit/s	STM-64	OC-192	800 to 1000 ps/nm
40 Gbit/s	STM-256	OC-768	60 to 100 ps/nm

Standards such as G.dsn from ITU-T aim to provide more accurate calculation charts.

These calculation charts are given for information only. They depend on the spectral pass-band of the optical signal transmitted, the modulation, and the sensitivity of the receiver.

If the limits of chromatic dispersion are attained, then appropriate compensators can be incorporated along the link to neutralize its effect. These compensators introduce negative delay values to bring the system back within the permissible limits of CD. Telcordia gives their specifications in the document entitled «GR-2854-CORE Generic Requirements for Fiber Optic Dispersion Compensators».

In the absence of internal modulation lasers, external modulation lasers can be used to limit the effects of chromatic dispersion (most DFB lasers now have external modulation).

Source function

The CD module can also be used as a light source.

In this case, connect the fiber into which you wish to inject the light from the source to the output connector of the CD plug-in.

To configure the CD plug-in as a light source:

1. Go into the **SETUP** menu of the OTDR tab of the CD plug-in.
2. Select **Mode: Source**

   All the menus of the OTDR are then grayed out except the laser line.
3. On the **Laser** line, select the wavelength desired for the source (the 4 wavelengths used for CD are available to choose from).
4. Press the **START/STOP** key to start or stop the laser.

OFI Module

10

This chapter describes the functions of the OFI module (Optical Fiber Installation) and its use.

The topics discussed in this chapter are as follows:

OFI module

The OFI module is used to make insertion loss measurements, ORL measurements and distance measurements.

The following functions are available with the OFI Module:

– Loss Test Set
– FOX (Fiber Optic eXpert)

Selection of the OFI module

Push the **SYSTEM** button.

Select the icon  to start the LTS function, and / or the icon  to start the FOX function, or the icon  to start the ORL function, using the key  .

LTS function

Principle of the optical power and attenuation measurements

Power measurement A power meter, is all that is needed to measure emitted or received power:

– to measure emitted power, connect the power meter directly to the output of the optical emitter;
– to measure the power at the input of an optical receiver, the power meter is connected to the end of the fiber, at the point where the optical receiver would be connected.

Attenuation measurements (optical link loss)

For measurement of the attenuation of power in a complete link or in elements such as sections of fiber, connections or optical components, a light source and a power meter are required.

This attenuation is usually deduced from the measurement of optical power at two points:

Attenuation $A_{(dB)} = P1_{(dBm)} - P2_{(dBm)}$

To perform accurate measurements, the following conditions are vital

- Use one of the light sources of the LTS or a light source which is stable both in time and as a function of temperature.
- Make sure that all connections and fibers and the receiving cell are perfectly clean.
- Use a reference link between the laser source and the test subject. If several measurements are to be made under identical light injection conditions, this reference fiber must not be disconnected during the period while measurements are taking place.

Insertion loss method

1 The power meter is first connected to the laser source via the reference fiber: P1 is measured.

2 Then the fiber to be tested is inserted between the reference fiber and the power meter: P2 is measured.

The difference between P2 and P1 gives the attenuation of the fiber under test.

It is preferable to use the same type of connector at both ends of the fiber being tested, to ensure the same connection conditions for measuring P1 and P2.

Accuracy of measurements

- A high degree of accuracy is often required. It is then necessary to perform a preliminary calibration without the fiber under test to eliminate the losses due to connections as far as this is possible. To do this, use the «Reference Value» function.

– For measurements in the laboratory, where both ends of the fiber are on the same site, the repeatability of attenuation measurements is better than 0.1 dB. For measurements in the field, where the two ends are on different sites, variations from one measurement to another are of the order of ± 0.2 dB (using a relative measurement).

Connections to the power meter and the source

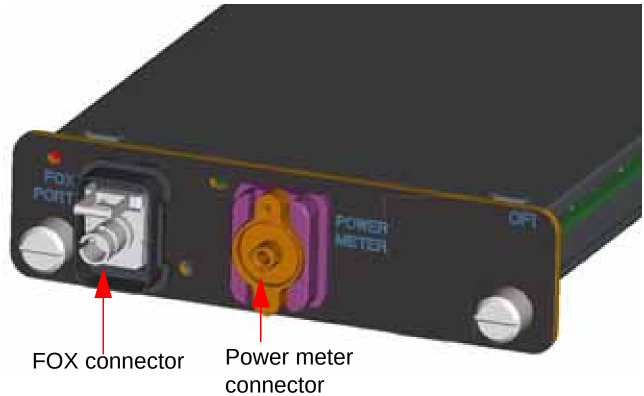


Fig. 60 Optical connectors

The type of optical connector used for the power meter is UPP (Universal Push Pull), which is compatible with all diameter 2.5 mm connectors (FC, SC, ST, DIN, E2000, etc.).

NOTE

The source connection is the same as the FOX port.

Configuring the LTS

To activate the function:

– Press the **SYSTEM** button

– Use the direction keys to select the LTS icon  (framed in green) and press the confirmation key : the icon in the frame will turn yellow.

The effect of this action will be to bring the power meter into use, but not to activate the source.

Configuring the measurement parameters of the power meter

The measurement parameters can be accessed with the **SETUP** key.

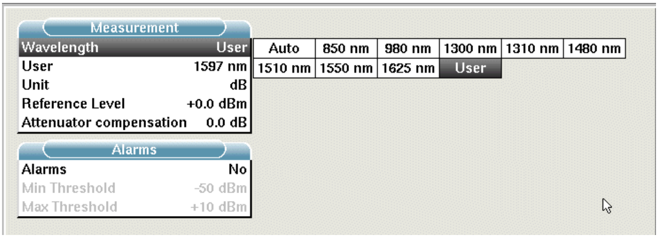


Fig. 61 Configuration of power measurement

Lambda

Selecting wavelength:
- Auto: the wavelength of the input signal will be automatically detected and selected to perform the measurement.
850, 980, 1300, 1310, 1420, 1450, 1480, 1490, 1510, 1550 or 1625 nm: measurement performed at specified wavelength.
- User: choice of wavelength on the next line in the menu.

User choice

(if the User option was selected in the Lambda line) selection of the wavelength between 800 nm and 1650 nm, in 1 nm steps, by means of the direction keys and .

Unit

Unit of power displayed:

- Watt, dBm for displaying absolute power

- dB for displaying a result relative to a reference (link loss)

Reference level

If dB units were chosen in the previous line, selection of the reference value for the wavelength selected. Using the direction keys, first choose the wavelength, then press the > key to access choice of the value (+XXX.XX), then confirm this value with the validation key .

This reference is also automatically available, in the **Results** page, using the **Set as Reference** key.

Attenuator compensation

Choice of level to be applied to the wavelength chosen for measurement to compensate for the loss due to the external attenuator (+XX.XX dB). First use the direction keys to choose the

wavelength, then press > to access choice of value, then confirm this value by pressing the validation key .

> **NOTE**
>
> To copy a Reference Level or a Attenuator Compensator on all wavelengths, select the reference wavelength and click on **Update for All Wavel.**.

Configuring the alarm parameters of the power meter

Alarm — Activation of the Alarm function : any result below the lower threshold or above the upper threshold will be displayed in red on the Results page.

Lower and upper thresholds :

Choice of lower and upper thresholds for each available wavelength, from -60 to +40 dBm (selected with the direction keys).

> **NOTE**
>
> To copy one value of the Lower or/and Upper threshold for all wavelengths, select the reference value and click on **Update for All Wavel.**.

> **NOTE**
>
> A continuous push on the direction keys, increments the value by 10 dBm.

Configuring and displaying the parameters of the source

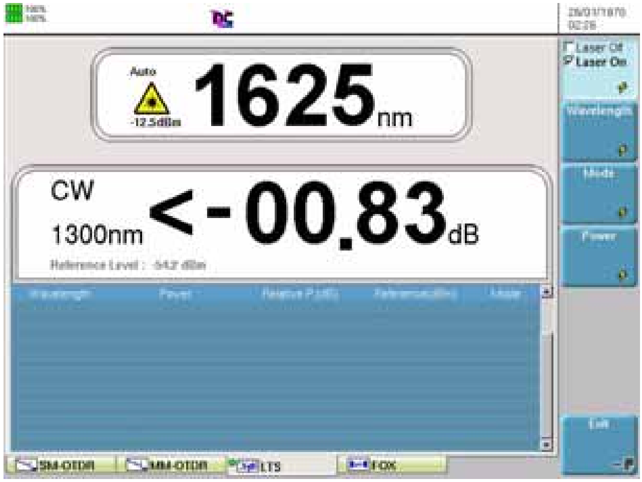


Fig. 62 Source configuration

When the laser is **on**, the icon  is displayed.

The parameters of the source can be accessed directly on the results screen of the LTS module, by pressing the **Source Configuration** soft key.

Wavelength	To change the wavelength when a multi-wavelength source is present (depending on option). The wavelength value is displayed.
Mode	To vary the mode of emission of the source. Possible modulation values are: – 270 Hz – 330 Hz – 1 kHz – 2 kHz – Auto (the sources emit on determined frequencies to enable the power meter to detect the wavelength used automatically) – Twintest (cyclical emission on all available wavelengths for a few seconds on each wavelength), compatible with the JDSU OLP 5/6/15/16/18.

– CW (continuous emission)

The mode used is displayed, above the icon  .

Power

In CW mode, you can choose the emitted power:

- either the nominal value: -3.5 dB

- or an attenuation of -3 or -6 dBm, with regard to this nominal value, to get a power of 6.5 dBm or of 9.5 dBm.

For all the **other modes** (270Hz / 330Hz / 1kHz / 2 kHz / Auto / Twintest), select one of the following emitted power: -12.5 , -9.5, -6.5 dBm.

Display of results and command

The results page called up by the **RESULTS** button**,** gives the information relating to the measurement in progress, results previously saved and the commands available for measurement and saving.

Result of the measurement in progress

The power measured by the power meter is displayed in large characters, in the units selected in the **SETUP** menu, together with:

– the mode of transmission of the signal measured: continuous (CW) or modulated to a frequency of 270Hz, 330Hz, 1KHz, or 2KHz.

– the wavelength of the signal measured.

– the reference level expressed in dB.

– the level of Attenuation Compensation.

Table of results

For one and the same fiber, the power meter displays a table of 9 results corresponding to the different possible wavelengths. The table shows the power measured in dBm, the relative power (in dB) and the reference level in dBm (if units = dB), together with the mode.

A measurement result is displayed in the table when the **Keep Result** softkey is pressed.

The **Clear Table** softkey orders deletion of all the results displayed in the table.

If the Alarm function has been activated, any result that exceeds the selected thresholds appears in red in the table. Otherwise, results are shown in the table in green.

When the instrument is switched off, results present in the table are saved.

Fig. 63 Results and commands of the LTS

Commands of the power meter parameters

When the LTS function is selected, the following softkeys are available on the results page:

<Set as reference>	Selects the current result as reference value to measure the attenuation of a link. This reference is displayed under the measurement result until a new reference value is chosen.
<Zero>	Adjustment of the Zero value when the power meter's optical input is closed with a plug.
<Keep Result>	Saves the result on the corresponding line of the table.
<Clear Table>	Deletes all the results recorded in the table.

Making a measurement

The power meter is started up as soon as the LTS function  is activated in the **SETUP** menu.

> **NOTE**
>
> Power measurement is automatically updated in consequence. The value «<-60 dB» is displayed when the laser is switched off and if the source output is looped on to the power meter input.

If the OFI module's source is used, the **START/STOP** key must be used to start or stop emission of light.

Power measurement

- Connect the light source to be tested to the rear connector (see "Connections to the power meter and the source" page 184).
- In the **SETUP** menu, choose the units dBm, dB or Watts.
- Press the **START/STOP** key to start the laser**.**

  The result will appear in the results page and can be memorized in the table (see "Table of results" page 188).
- Press the **START/STOP** key to stop the laser**.**

Optical link loss

Setting the zero value of the power meter

> It is important to set the zero of the power meter before making any measurements where accuracy is required, as the noise from the photodiode fluctuates over time and with variations in temperature.

1. Fix the plug over the optical input of the power meter so that no light can reach the photodiode of the power meter. If the zero adjustment is made without this plug, an error message may be displayed, as the photodiode will detect too much light.
2. In the **Results** page, press the **Zero** soft key.

Carrying out the reference measurement

1. Fix the adapter corresponding to the jumper to the optical connector of the power meter.
2. Connect the jumper between the input of the power meter and the output of the source.
3. Configure the same wavelength on the source and the power meter.

   The power measured is displayed in the results page of the LTS.
4. Press the **Set as Reference** soft key to save the result displayed as reference value.

Measurements on the fiber under test

After defining the reference value, proceed as follows to make the measurement:

1 Fix the jumpers and connectors needed to connect the fiber to be tested between the source output and the power meter input.

2 In the set-up menu, select dB units.

3 The power displayed in the Power Meter window corresponds to the optical loss of the link tested. It can be displayed in the table (see "Table of results" page 188).

FOX[1] Function

The FOX function is used to make automatical, bidirectional optical power measurements and / or ORL measurements at one or several wavelengths.

This function is also used to make a distance measurement of the link under test.

Two Base Unit are required, each one equipped with an OFI module at each end of the fiber.

The OFI module 81xx is also compatible with the OFI-2000.

With the FOX function , the two Base Units can communicate and send messages to each other.

Configuration of the FOX automatic measurement

Two types of parameters can be modified in the FOX configuration of the OFI.

– The Acquisition parameters

– The results screen parameters.

1.Fiber Optic eXpert

Fig. 64 FOX parameters

Acquisition parameters

- **Laser** All / 1550 / 1310 / 1625 / 1550 + 1310 / 1550 + 1625 / 1310 + 1625
- **Measurement** Loss / Loss + ORL / Loss + Length / Loss + ORL + Length

> **NOTE**
>
> The acquisition and measurement parameters can change according to the OFI plug-in used.

Results screen parameters

- **Group Refr. Index**
  - Preset index
  - 1550 SM

Preset Index	**1550 SM**
User	de 1.30000 à 1.70000
Corning SMF-28	1.46810
Lucent Truewave	1.47320
SpecTran SM	1.46810
Litespec	1.46700
ATT SM	1.46700
Fitel Furukawa	1.47000
Corning SMF-DS	1.47110
Corning SMF-LS	1.47000
Corning Leaf	1.46840
E-SMF	1.46450

- **Unit** km / kfeet / miles

– **Alarms** No

Active ; used to set alarms.

  – Loss: enter the loss threshold for each wavelength (in dB).
  – ORL: enter an ORL threshold for each wavelength (in dB).
  – Delay: enter a delay time (in µs).
  – Length: indicative value, changes according to the delay time and the fiber index.

To change the alarms values, use the direction keys ◀ and ▶ or the numeric keypad.

File Storage parameters

– **Filenaming** [Cable_Id][Fiber_Num][Fiber_Code]
– **Auto Store** Yes (cannot be modified)
– **Fiber Nbr Increment** Yes (cannot be modified)

In the FOX function:

– the measurement results are automatically saved
– the fiber number is automatically incremented.

To display the fiber to be tested, push the **START/STOP** button in the results page of the FOX function (see "Choosing the fiber to be tested" page 199).

Establishing a reference

Before making a power, a ORL and / or distance measurement with the FOX function of the OFI module , you have to take references.

1 On the **RESULTS** page, push the **References** button.

Different references can be taken:

– For a loss measurement
  – Side by Side reference
  – Loopback reference
– For an ORL measurement
  – Power emitted reference
  – Zero ORL

NOTE
As the ORL is an option, establishing a reference for this measurement is not automatically available with the OFI module.

Establishing a reference for loss measurement

Before any measurement, you must establish references.

Two methods can be used to take references: taking a side by side reference and taking the reference in a loop-back mode.

Taking a side by side reference

> **NOTE**
> This reference can only be performed when the two Base Unit are at the same location.

1 On the **RESULTS** page, push the **References** key.

2 Push the **Loss Side/Side** key.

3 Link the FOX connectors of the two Base Units by using two jumpers.

4 Push on **Go** key.

Reference date.
Type and serial number of the distant instrument

Fig. 65 Taking a side by side reference (8000 series example)

Once the references are taken, the reference screen is updated for the wavelengths available on the distant instrument. It indicates the type of reference used.

The date of the reference as well as the type and serial number of the distant instrument are indicated on the first line of the table.

If the reference is correct, disconnect the jumpers at the middle point, in order to insert the fiber to be tested.

If the reference taken is not correct, take a new reference.

> If the reference measurements are too weak, a warning is displayed.
>
> Clean all connections to improve the reference measurements.

> The reference is only valid if the jumpers are not disconnected from the Base Unit.

Taking the reference in a loop-back mode

> **NOTE**
>
> This reference can be made wether the Base Units are on the same site or not.

1. Connect the optical output of the source (FOX port) to the optical input of the power meter by means of a jumper.
2. Push the **References** key.
3. Push the **Loss Loopback** key.
4. Push the **Go** key.

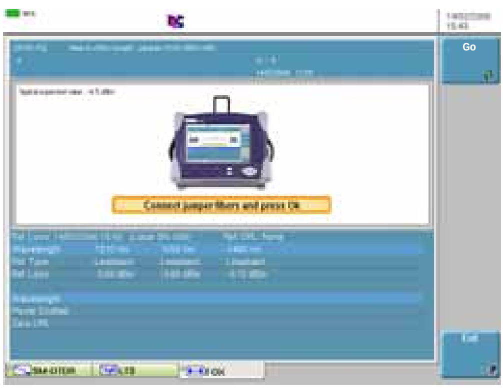


Fig. 66 Taking a reference in a loop-back mode

Once the reference is taken, the reference table is updated for the wavelengths available on the local instrument. It indicates the type of reference used.

The date of the reference as well as the type and serial number of the local instrument are indicated on the first line of the table.

If the reference is correct, disconnect the jumper in order to connect the fiber to be tested.

If the reference is not correct, take a new reference.

Establishing a reference for an ORL measurement

Two steps must be carried out to take a reference for a ORL measurement:

1. Power emitted reference
2. Zero ORL adjustment

Follow the order given above to take the reference. They are not two different processes but two steps necessary to establish a reference for an ORL measurement

NOTE

As ORL is an option, establishing a reference for this measurement is not automatically available with the OFI module.

ORL Emitted power

1. Link the FOX port to the power meter input port via a jumper.
2. Click on **ORL Power Emitted**
3. Click on the **Go** key.

   The power measurement from the laser signal emitted is completed.

Fig. 67 Establishing a reference for an ORL measurement

Once the reference has been taken, the reference screen is updated for the wavelengths available on the local instrument. It indicates the type of reference used.

As the Zero mesurement as not yet been done, the first line of the table displays the message Ref ORL : Incomplete.

ORL Zero adjustment

Once the Power Emitted measurement has been carried out, the Zero adjustment can be performed:

1. Disconnect the jumper from the external power meter and wrap this jumper, still connected to the FOX port, around the mandrel (6 to 7 times).
2. Click on **ORL Zero**
3. Push the **Go** key

Fig. 68 Adjustement of the ORL Zero

Once the reference has been taken, the reference screen is updated for the wavelengths available on the local instrument. It indicates the type of reference used.

> Once the two references are complete, the date as well as the type and serial number of the local instrument are displayed on the first line of the table.
>
> If not, the message Ref ORL : Incomplete is displayed.

Measurement acquisition

Before making an automatic FOX measurement, check that:

– both Base Units (local and distant) as well as the OFI module on each instrument are powered on and the FOX function selected.

– the FOX function is correctly configured (**SETUP** menu).

– each end of the fiber is correctly connected to the module.

– the fiber and jumpers are in good condition.

To display the fiber measurement page, push the **RESULTS** key.

The page displays:

– Both instruments connected to the link (local and distant).

– The **Results** table with the last measurement made.

– The tested fiber parameters

Choosing the fiber to be tested

Once the results page is displayed, push the **START/STOP** button.

The details of the next fiber to be tested are displayed.

Fig. 69 Details of the following fiber to be tested

To test a different fiber to the one displayed, select the new fiber according to its number or its color code.

Use the direction keys ◀ and ▶ to change the number or color code of the fiber to be tested.

Changing the fiber number involves a modification of the color code and vice versa.

Making the measurement

Before making the measurement, check that the reference measurements are correct (see "Establishing a reference" page 193).

Push the **START/STOP** button once more to start the measurement of the selected fiber.

The results are displayed as the sequence progresses, on both Base Units.
During the measurement, the soft keys on the right of the screen are inactive.

Once the measurement has finished, the Base Unit beeps to signal the end of the sequence. The beep differs, depending on wether the measurement has completed correctly or according to the measurement/ alarm status.

Identifying the distant module

Before making a measurement, you can check presence of the distant module.

Once the results page is displayed, click on **Identify distant**.

The distant module identification is made automatically.

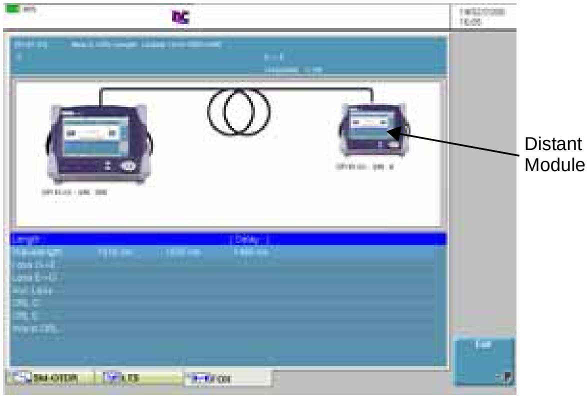


Fig. 70 Distant module Identification

Data from the distant instrument is displayed: The serial number and the operator name on this instrument.

Check this data before making a measurement or taking a reference.

Displaying results for a FOX automatic measurement

The measurement results are displayed as the sequence progresses, on both Base Units.

During the measurement, the following icon is displayed and the keys on the right of the screen are inactive.

Once the measurement has finished:

– the icon turns grey
– keys are active.
– the Base Unit beeps to signal the end of the measurement.

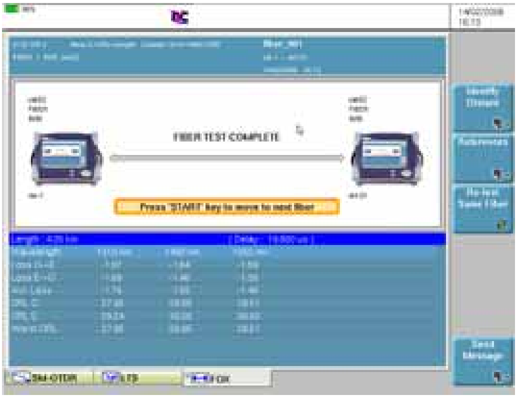


Fig. 71 Result of a FOX automatic measurement

The data displayed in the table can vary according to the acquisiton parameters (see "Configuration of the FOX automatic measurement" page 191).

Sending a message

When two Base Units are connected at each end of the fiber, via their FOX port, they can send messages to each other.

Two types of messages are available:

- predefined messages (10)
- User-definable messages(4)

The message sent by one Base Unit will be displayed on the screen of the other Base Unit.

To send a message to the distant Base Unit:

In the Results page, push the **Send Message** key.

Fig. 72 Messages that can be sent to the distant Base Unit

A menu with the 14 messages available is displayed.

Select the message to be sent using the direction keys and .

To enter a user message, select one of the last 4 messages (called User message 1 / 2 / 3 / 4) and push the direction key .

The edition keypad is displayed.

Enter the text you want and push the **Valid** key on the keypad or on the screen.

Push the **Send Message** or **Select** key.

On the distant Base Unit, the message is displayed with the icon .
Press any key to delete the message.

NOTE

If the link is not established between the two Base Unit, the following error message is displayed: «No acknowledge received for the SMS sent».

Manual ORL

The OFI module can be equipped with the ORL function (option), which allows to make an ORL manual measurement .

However, before making this measurement, the references have to be established once the ORL tab has been selected on the OFI module or on the Base Unit, in the **SYSTEM** page.

Fig. 73 Selection of the ORL function

> The functions LTS, FOX and ORL can be selected at the same time on the OFI module.
>
> However, the LTS and ORL functions from the Base Unit cannot be selected simultaneously.

Establishing a reference for an ORL manual measurement

Two steps must be carried out to take a reference for an ORL manual measurement:

1 Power emitted reference: see "ORL Emitted power" page 196

2 Zero ORL adjustment: see "ORL Zero adjustment" page 197

> Follow the order given above to take the reference. They are not two different processes but two steps necessary to establish a reference for an ORL manual measurement

> Establishing references is only valid for a specific module or function. For example, the references for an ORL automatic measurement are only available for the FOX function (a new reference must be redone for an ORL manual measurement.).
>
> Moreover, the Manual ORL references made with the Base Unit are not valid with an OFI module.

> **NOTE**
> As ORL manual is an option, establishing a reference for this measurement is not automatically available with the OFI module.

Measurement acquisition

The page displays:

- The results screen with the wavelength and the ORL references established.
- The table where are saved the ORL measurements.

Making the measurement

Before making the measurement, check that the reference measurements are correct (see "Establishing a reference for an ORL manual measurement" page 203).

Push the **START/STOP** key to start the measurement.

Display of results for an ORL manual measurement

To display the fiber measurement page, push the **RESULTS** key.

For each wavelength, push the key **Keep Result** to display the result in the table.

The **Clear Table** softkey orders deletion of all the results displayed in the table.

If the Alarm function has been activated, any result that exceeds the selected thresholds appears in red in the table.

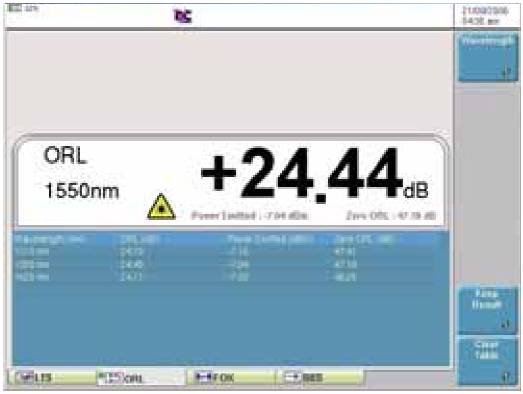


Fig. 74 Results for an ORL manual measurement

Once all the results are displayed, click on the **FILE** button to save the file in a directory.

File Management

Storing results

Although each measurement is automatically stored (for FOX results only), it is possible to save the results under a different file name, directory etc.

Once the results are displayed:

1. Push the **FILE** button
2. Select **Setup** with the key **Setup/Explorer**
3. Modify the parameter you want in the **FILE** configuration menu
4. Click on the **Store Trace** key

The FOX files are saved with the extension «.FOX».
The LTS files are saved with the extension «.LTS».
The ORL files are saved with the extension «.ORL»

> **With the LTS and ORL results, two files are saved :**
>
> The first file is to be used with the Base Unit and allows all LTS measurements results to be retrieved. It is saved with the extension «.LTS» or «.ORL».
>
> The second file is an ASCII file using tabulations to separate values. It is saved with the extension «.txt» and cannot be opened by the Base Unit. It has been designed to be used with a spreadsheet program on a PC where it allows all LTS measurement results to be retrieved and formatted in a customized table.

For more details on file management, see "File management" page 219.

Recalling files

To recall a LTS, FOX or ORL file:

1. Go to the **Explorer**
2. Select the directory
3. Select the file to load
4. Click on **Load**
5. Click on **View Trace(s)** or **Load Trace + Config.**.

   The selected file is opened

Multi Test Access Unit

11

This chapter describes the function of the MTAU (Multi Test Access Unit) module and its use.

The topics discussed in this chapter are as follows:

The main application of this module is to be used together with the 8000 platform.

Function of the MTAU module

The MTAU is a passive module (switch) used to route the signals from the different measurement plug-ins to one and the same fiber.

The advantage is to be able, for example, to make all the characterization measurements (insertion loss, reflectometry, chromatic dispersion, spectrum and polarization measurements) with a single 8000 Base Unit[1] without ever disconnecting the fiber.

Connections

The MTAU plug-ins offered are of two types:

1 A common port with 2 ports A and B

2 A common port with 3 ports A, B and C and a mirror.

The fiber to be tested must be connected to the common port .

The other ports are connected to the measurement plug-ins, e.g. OTDR, CD, OSA, PMD, or an external instrument.

Two 8000 Base Units can be used at each end of the link under test for maximum efficiency and to carry out the largest number of tests in both directions.

> **NOTE**
>
> The MTAU is not directional. It is possible to use the common port either as an input or as an output.

1.Equipped with suitable plug-ins, for example an OTDR/CD plug-in and a WDM/PMD plug-in.

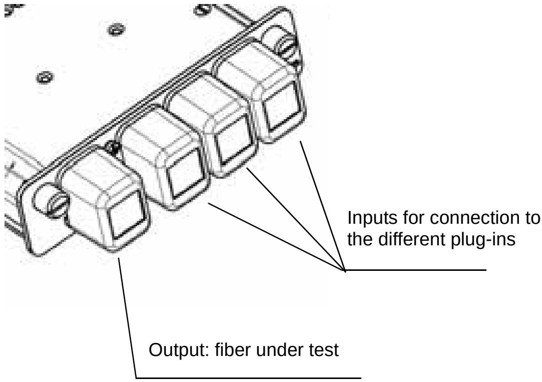
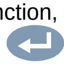


Fig. 75 Example of an MTAU plug-in with 1 common & 3 ports plus 1 mirror

> **NOTE**
>
> It is possible to use the Mirror port (MTAU with 4 ports) to enhance reflectance at the end of the fiber, and obtain more effective CD results. In this case, the input port at the extreme end of the fiber becomes a mirror.

Configuration

To use the MTAU function, go into the **SYSTEM** menu and select the icon  using the key .

Then go into the **SETUP** or **RESULTS** menu (the same page is displayed for this plug-in) to access the screen from which the the input channels can be switched.

The screen displays a diagram of the input and outputs to the switching device.

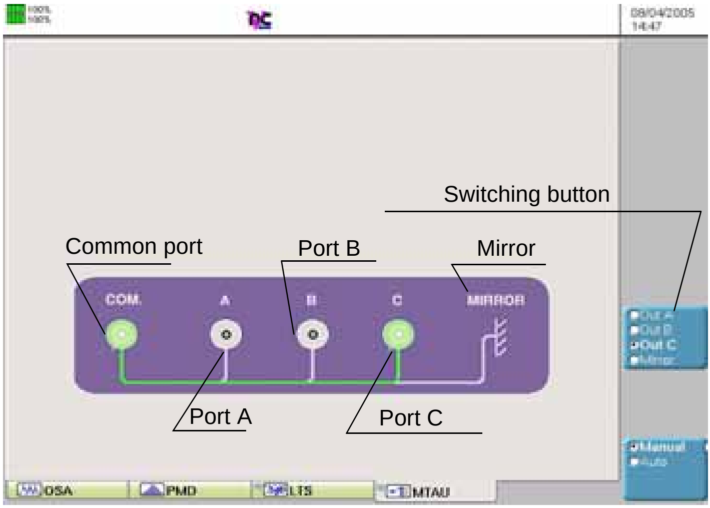


Fig. 76 Manual mode for the MTAU plug-in

Manual mode

To switch each output, use the button **Port A/Port B/Port C/Mirror**. Each click on this button switches the next output port.

The active port and the link to the common port are shown green, while the other ports remain grey.

On the front of the plug-in, a red LED next to the port selected also lights up in order to provide a permanent, physical indication of which output is active.

NOTE

To optimize manipulation, always use the **RESULTS** key to change over from this screen to the screen corresponding to each measurement.

Auto mode

The auto mode offers the best way to test a full cable. The purpose is to set a sequence of operations, which will be performed for each fiber, one after the other with no need to modify the configuration or to go to each measurement tab. All operations can be handled from the MTAU tab.

> **NOTE**
>
> The switch between measurement (if necessary) is automatic. Nevertheless launching each measurement remains the user responsibility, as some extra equipment might be needed (ex broadband source for PMD).

Select **Auto** on the key **Manual/Auto** to switch to auto mode or vice et versa.

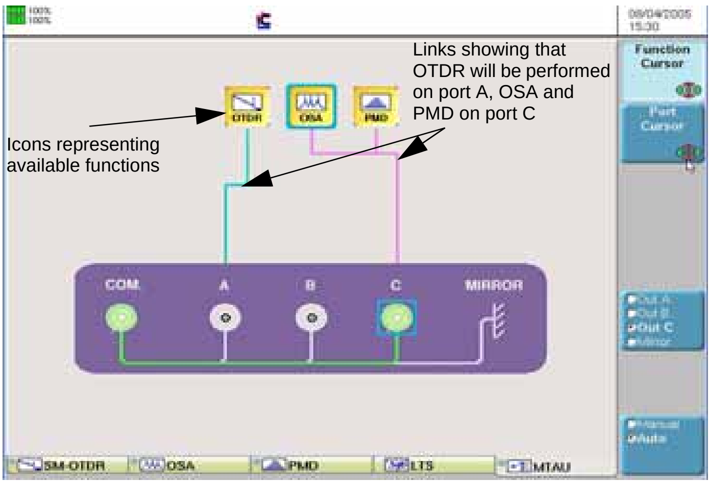


Fig. 77 Auto mode for the MTAU plug-in

Different icons appear at the top of the screen, showing different available functions. According to your 8000 Base Unit configuration, you may have all the following functions available :

- OTDR
- CD
- OSA

– PMD
– AP

Configuration of the sequence of tests

1 Make sure you select all necessary functions in the **SETUP** menu.

> **NOTE**
>
> Icons for selected functions appear in yellow, icons for available but unselected functions appear in grey.

2 Go to each tab if necessary to make sure all setup values are correct for each selected function.

3 Select the **Function Cursor** key, and choose which function you wish to configure in the list of icons.

4 Select the **Port Cursor** key, and choose which port is connected to the corresponding function.

5 Click on the key to validate the association. A solid link will be drawn between the function and the port you selected (see the figure "Auto mode for the MTAU plug-in" on page 211).

6 Go back to step '3' for the next function if necessary.

> **NOTE**
>
> It is not possible to affect the same function to different ports.

> **NOTE**
>
> Functions that are offered by the same physical module may only be connected to the same port.

When the sequence is completely configured, you can view which function is connected to which port thanks to all the solid links (see the figure "Auto mode for the MTAU plug-in" on page 211Fig. 77Fig. 77Fig. 77).

Various link colors are offered to differentiate each port :

– blue for port A
– red for port B
– pink for port C

IMPORTANT

If a function used in the sequence configuration is deselected in the **SYSTEM** page, the configuration automatically deletes the corresponding link but keeps the rest of the configuration in memory. Reselecting the function does not automatically recreate the link.

NOTE

The last configuration is saved in the 8000 Base Unit and may be retrieved after a complete reboot, unless the hardware configuration has changed (for example if a new module is inserted).

Performing the sequence of tests

1. Connect the fiber to test to the MTAU common port.
2. Click on **START/STOP** to start the sequence.
3. A message is displayed requesting to confirm you wish to start the measurement, such as «Start SM-OTDR measurement ?».

   Answering **No** cancels all the sequence but keeps the configuration in memory.

   Answering **Yes** starts the first measurement.
4. After each measurement is done, a new message follows if another measurement is configured in the sequence such as in step 3
5. The sequence is terminated when no more message is displayed and the led from the MTAU tab changes from . to . Go back to step ’1’ with a new fiber.

The order of the sequence will take in consideration the order in which the sequence is displayed on screen, starting with the ports order, then with the functions order. In our example, the sequence will measure successively OTDR, OSA then PMD.

Some messages may appear during the sequence to request specific actions necessary for the measurement (just like «check source» appears before a PMD measurement).

The focus in on the active function and the link becomes green.

Even though this is not necessary, it is possible to go to the measurement corresponding tab when a function is being used, and see the results of the acquisition.

> If a function is deselected in the **SETUP** page while the sequence is launched, the sequence is automatically updated and continues if the function was not currently used, or is immediately stopped otherwise. In this last case, an error message is displayed indicating that the function has been deselected.

if you wish to stop a measurement but not the sequence, go to the corresponding measurement tab and click on **START/STOP**

Broadband source BBS

12

This chapter describes the function of the BBS (Broadband Source) module and its use.

The topics discussed in this chapter are as follows:

Function of the BBS module

The BBS is a broadband source, covering several wavelength ranges (from 1480 to 1640 nm for BBS1 and from 1260 to 1640 nm for BBS2). It is used to measure the attenuation profiles and the PMD of optical fibers.

Activation process

To use the BBS function, go into the **SYSTEM** menu and select the BBS icon  using the key .

Then go into the **SETUP** or **RESULTS** menu (the same page is displayed for this plug-in) to access the screen of the BBS module.

Press the **Laser On** key.

Entrer the password 4877, using the direction keys .

Press the **Confirm** button to valid the password.

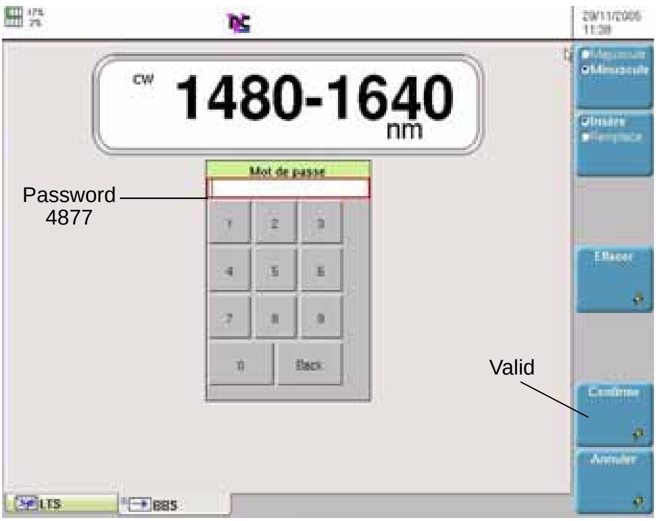


Fig. 78 Validate the password

The laser is on and the screen displays the icon

Press the **Laser Off / On** key to deactivate or activate the laser.

> **NOTE**
>
> To lock the instrument, simply un-select the BBS module. Any user coming next will be prompted for a password when the module will be re-selected.
>
> Also, after powering down the unit, you will also be prompted for the password.

Remote interlock connector

The BBS module has been equipped with a remote interlock connector (SMB type) on its front pannel. This is to protect the user from injury when using class IIIb light sources.

The use of a Remote Interlock system is specified with class IIIb sources by 21 CFR 1040.10 (USA).

If the short circuit at the SMB connector is opened, the broadband light source is switched off immediately and cannot be switched on until it is closed again.

> **NOTE**
>
> Note that the BBS modules are of class 1M under the IEC 60825-1: 2001 international standard.

Fig. 79 Remote interlock connector

File management

13

The topics discussed in this chapter are as follows:

File configuration menu

This menu is used to configure various parameters common to the whole of a cable.

– Press the **FILE** button. The following File menu appears.

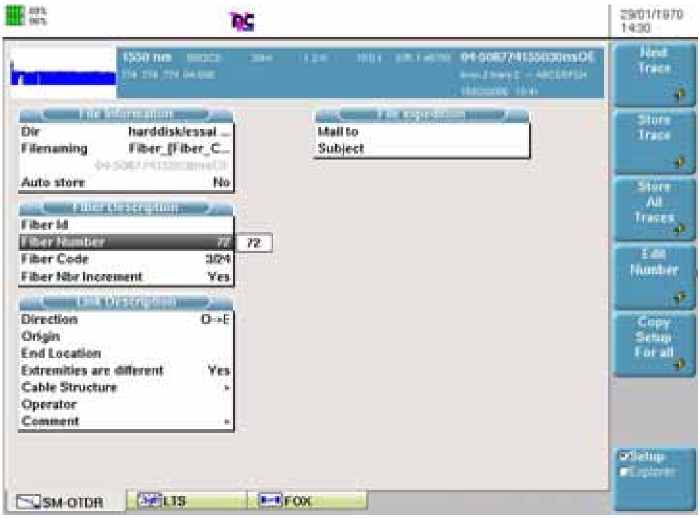


Fig. 80 File Menu (example with OTDR plug-in)

Managing tabs

Tabs give access to the File menu of each application (OTDR, OSA, Power Meter, etc.) present in the modules and plug-ins of the instrument.

It is possible to open a file even if the corresponding plug-in is not present in the instrument (e.g. OSA file without OSA plug-in). A new tab then temporarily manages this application.

When several different applications (corresponding to modules or plug-ins for different measurements) are managed by the Base Unit, pressing the **FILE** key several times in succession changes from one tab to another to give access to the file configuration of the desired application (e.g. OTDR, OSA, etc.). See "Tabs" on page 31.

File signature

The acquisition parameters of the trace contained in the selected file are displayed at the top of the screen together with a small-scale representation of the trace (provided it was acquired on a MTS / T-BERD Base Unit) (see "Mini-trace" on page 31).

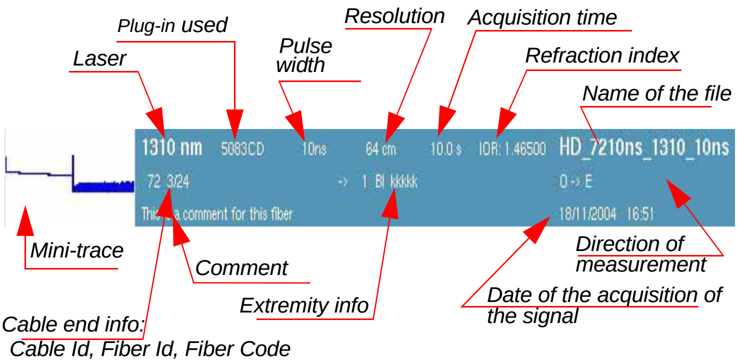


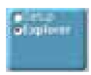
Fig. 81 Example of signature of an OTDR file (in the File Menu)

File information

Current directory

The **Dir.** line of the menu shows the directory in which the traces will be stored.

This line can also be used to change the active storage medium directory. To do this, launch the directory editor by means of the key: ▶.



The directory edited must exist, otherwise it will not be taken into account. Change of medium and the creation and/or deletion of directories can only be done through the file explorer (see "Explorer Function" on page 230)

When recalling a trace, fiber parameters are shown in the signature, but not necessarily in the **FILE** menu. The **FILE** menu is used to edit parameters for the current or next acquisition, or to modify the signature of a stored trace only.

Rules for naming files

In the name of the file, it is possible to program automatic inclusion of parameters such as the name of the fiber, fiber code, identifiers (of the cable, its origin, its end) or the measurement parameters (direction, resolution, wavelength, pulse length).

The <Filenaming> line shows the current filenaming rules and can be used to modify them.

To edit or modify these rules:

1. Go to to the **Filenaming** line
2. Press ▶ to call up the edit menu
3. Move around in the edit screen using the direction keys
4. Select the desired characters and parameters
5. Confirm each parameter or character selected by clicking on
6. Select **Validate** or **Cancel** to quit the edit screen (according to whether the modifications are to be applied or not).

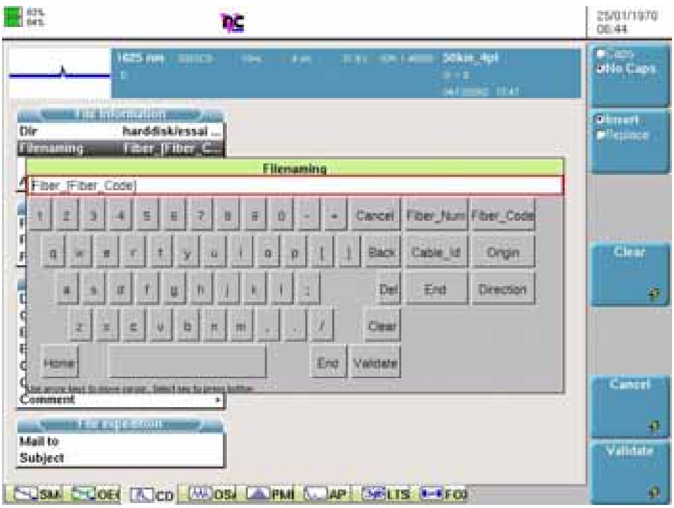


Fig. 82 Editing filenaming parameters

Example of filenaming:

File parameters	**Filenaming rules selected**	**Filename obtained**
Resolution = 16 cm Fiber number = 1	ABC[Resolu-tion]Fiber_[Fiber_Code]	ABC16_cmFiber_1

> A file name can consist of up to 40 characters. However, beyond a certain length, the names will be truncated in the display on the Base Unit, the end being replaced by «...».

Name of a file

After an acquisition, and as long as the result has not been saved, the line below **Filenaming** gives the name made up in accordance with the filenaming rules.

If the file has been recalled from a memory, the line below **Filenaming** shows its name irrespective of whether it respects the current filenaming rules.

This name can then be modified by calling up the edit menu using the button ▶. If a modification is then made to the filenaming rules, the file name will not be modified. To return to a name made up in accordance with the filenaming rules, simply delete the existing name.

> Editing the name enables the trace to be saved in a new file (with a new name), but it cannot rename the existing file (this function is possible in the Explorer menu - see "Storage media" on page 231). Thus the new name will not be taken into account until the trace is saved again.

Auto store

If this option is validated, the trace or traces resulting from each acquisition are automatically saved according to the filenaming rules.

Fiber information

This paragraph gives the fiber information for the extremity defined in **Direction**. If the direction is O->E, then the fiber information concerns the origin. If the direction is E->O, it concerns the extremity.

> **NOTE**
> The information entered in the Fiber information window concerns the editing and/or modifications of the cable and fiber parameters. When a trace is recalled without recalling its configuration, the parameters of this trace will be present only in its signature.

Fiber Name

This name consists of an alphanumerical part entered by means of the edit menu, followed by the fiber number. This number is automatically incremented or decremented as a function of the fiber code.

Fiber code

The fiber code corresponds either to the fiber number, or to a color code, according to the choice made in **Cable structure> Color Coding**.

If a color code is selected, it can consist of the codes for the tube, the ribbon and the fiber itself. Its composition is defined in C**able Structure> Cable Content**.

Incrementing fiber number

In **Increment fiber number** mode, the fiber code is automatically incremented at each new file-save.

Incrementation is done as a function of:

- the max. number of fibers, tubes and ribbons defined in Cable Structure (**Max Tubes, Max Ribbon, Max Fibers**)
- the composition of the color code, always incrementing first the fiber number, then the ribbon number, then (if applicable) the tube number
- the choices made, for each color code, in **Cable Structure** (Tube Coding, Ribbon Coding, Fiber Coding) and in **Code Definition** (see "Cable structure" on page 226).

The fiber number may be incremented or decremented directly with keys ◀ and ▶. or using the numeric keypad

> **NOTE**
> The Fiber Code and the fiber number concatenated with **Fiber Name** are interdependent: they are incremented or decremented at the same time. However, the fiber number remains a number only, while the fiber code is alphanumerical. Whether it includes a color code or not (see "Cable structure" on page 226), it may be composed of one, two or three parts (see figure page 225).

<table>
<tr><td colspan="5">Fiber and cable parameters used in the example:

Fiber Name: ’Fiberx’
Cable Content: ’Tube/Fiber’
Max Tube: 12
Max Fiber: 24
Coding used for the fiber and the tube: TIA</td></tr>
<tr><td></td><td colspan="2">Fiber N</td><td colspan="2">Fiber N+1</td></tr>
<tr><td>Color Code</td><td>Yes</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td><Fiber Name></td><td>Fiberx24</td><td>Fiberx24</td><td>Fiberx25</td><td>Fiberx25</td></tr>
<tr><td><Fiber Code></td><td>Bl/Aq-</td><td>1/24</td><td>Gold/Bl</td><td>2/1</td></tr>
</table>

Fig. 83 Example of incrementation of fiber code

Link description

The information entered in the Link Description window concerns the editing and/or the modifications of the cable and fiber parameters. When a trace is recalled without recall of the configuration, the parameters of this trace will be present only in its signature.

Direction

The direction shows if the acquisition has been made from the origin to the extremity (O->E) or from the extremity to the origin (E->O). Changing direction makes it possible, when different extremities are handled, to see the parameters of the fiber for the other extremity.

Origin

The name of the origin of the link may be entered here.

Extremity

The name of the extremity of the link may be entered here.

Different extremities

In some cases, it is interesting to save different information for the origin and the extremity of the cable.

If this option is validated, it is possible, after selecting the extremity to be edited in the **Cable Structure** menu, to modify the values specific to the cable (cable name, color coding, content of the coding), for each of these extremities. See chapter "Cable structure" on page 226)

To display/modify the data specific to the fiber (name and code), it is necessary to change direction temporarily. In the "O->E" direction, the information on the origin can be edited, and in the "E->O" direction, that on the extremity.

Cable structure

This line opens a sub-menu, all the parameters of which can be different for each extremity.

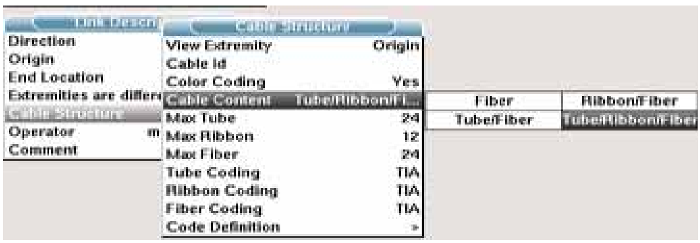


Fig. 84 Cable structure menu

View Extremity — If the extremities are declared different (see "Different extremities" on page 225), on the <View Extremity> line, it is possible to change from the «Origin» parameter to the «Extremity» parameter.

> The **Cable Structure** window is specific to an extremity. Each structure keeps its own parameters by default. Modifications made to the one are not automatically applied to the other. Thus, after the values relating to the origin have been modified, it is normal not to find these same values entered for the extremity.

Name of cable — Name of link

Color Coding — Choice of whether or not to apply a color coding to the fiber. This choice is made at link level, as all the fibers of a given link, for a given extremity, will be coded the same way. This choice modifies the result of the <Fiber Code> line. See "Incrementing fiber number" on page 224.

Cable content — Shows how the color code is to be used (see figure "Cable structure menu" on page 226):

– <Fiber> : Only the color code of the fiber is proposed (example: ’Gold’)

– <Ribbon/Fiber>: The color code of the fiber is preceded by that of the ribbon, and separated by a ’/’ (example: ’Bl/Or’)

– <Tube/Fiber>: The color code of the fiber is preceded by that of the tube, and separated by a ’/’ (example: ’Br/Or’)

–=<Tube/Ribbon/Fiber>:

The color code of the fiber is preceded by that of the tube, then by that of the ribbon; the three being separated by a ’/’ (example: ’Br/Bl/Or’). See "Incrementing fiber number" on page 224.

Max tube — Shows the maximum number of tubes in the cable for the extremity selected. This information influences the automatic coding of the fiber. See "Incrementing fiber number" on page 224.

Max ribbon — Shows the maximum number of ribbons in the cable for the extremity selected. This information influences the automatic coding of the fiber. See "Incrementing fiber number" on page 224

Max fiber — Shows the maximum number of fibers in the cable for the extremity selected. This information influences the automatic coding of the fiber. See "Incrementing fiber number" on page 224

NOTE

Certain parameters are not valid in the configuration selected. Thus, if no tube is selected in **Cable Content**, all the lines relating to the tube concept will be deactivated (grayed out in the menu).

Tube Coding, Ribbon Coding, Fiber Coding

The lines Tube Coding, Ribbon Coding and Fiber Coding enable selection of the color coding of the tube, the ribbon and the fiber from 5 different codes described below: TIA, USER 1, USER 2, USER 3 and USER 4.

Code Definition — The Code Definition line opens a sub-menu, with which the different color codes possible on the

instrument can be displayed and modified (see figure "Color code definition" on page 228).

Five different codes can be managed by the Base Unit, including a standard code.

The standard code (TIA) may be displayed but it cannot be modified.

The other codes, called by default USER1, USER2, USER3 and USER4, can be entirely personalized.

–Edited code	selects the code for display or modification.
–Copy name	to give a new name to the code selected, press the ▶ key, which calls up the edit menu.
–View codes	displays the color codes 1 to 12 or 13 to 24.
–Code 1..23	Use the arrow ▶ to modify the codes if necessary.

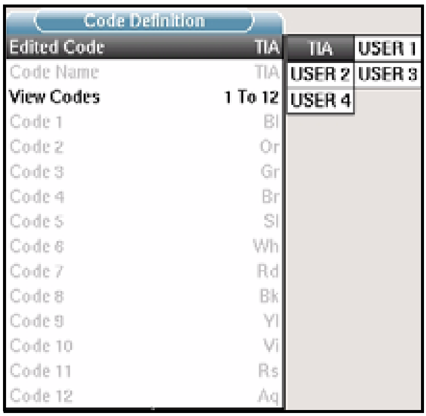


Fig. 85 Color code definition

Operator Use the arrow ▶ to enter the name of the operator carrying out the measurement.

Comment

In contrast to the other data in this menu, the comment is specific to a fiber, and not to the whole cable. This line is thus used to enter a new comment and not to display it. The comment appears at the top of the screen, with the other parameters of the fiber (see figure "Example of signature of an OTDR file (in the File Menu)" on page 221).

File expedition

This sub-menu appears when the option <mail> has been configured with one media, for example Ethernet, in the system setup menu (see the base manual of the Base Unit, reference 8000M02 for example.)

To send a mail, you must have filled the 2 following fields :

<Mail to>	Use the arrow key ▶ to enter in the edition window, and enter the name of the recipient.
<Subject>	Using the same key, enter the subject of the mail or a comment if necessary.

Buttons on the right of the screen

Saving traces

Fig. 86 Save

These buttons are used to save one or more traces

To copy the configuration on to all the tabs <Copy Setup for all>

Fig. 87 Copy Setup For All

The button **Copy Setup For all** applies the configuration modifications made in the File menu displayed into the File menus of the other applications managed by the base (appearing in the other tabs).

Explorer Function

Fig. 88 Setup / Explorer

To access the Explorer function, after pressing the **FILE** button, press the **Setup/Explorer** key.

Description of the explorer

The explorer is used to select the storage medium, and to create or rename directories and files:

– The left-hand part presents the storage architecture. Use the keys ▲ and ▼ to move around among all the media and their respective directories.

– The right-hand part displays all the files present in the directory selected.

The direction keys can be used to move horizontally between the two parts and vertically within each zone.

At the top of the screen, the file signature selected is repeated (see "Example of signature of an OTDR file (in the File Menu)" on page 221).

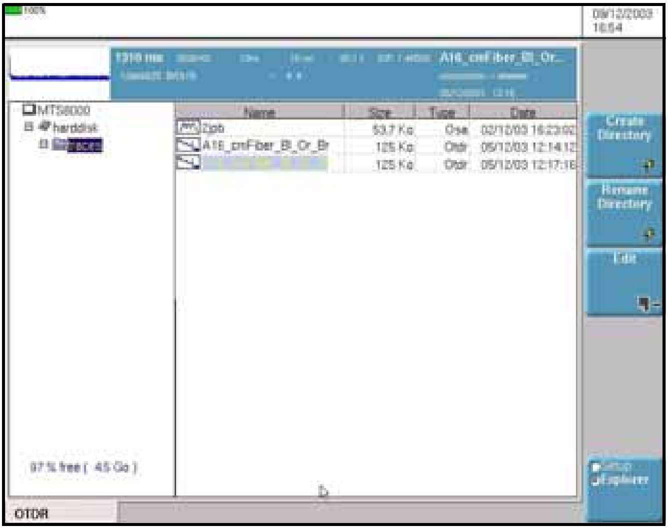


Fig. 89 Example of explorer (with files OTDR and OSA)

Storage media

For saving or recalling data, the Base Unit offers a wide choice of media, both built-in and external.

Free space on selected media is clearly displayed at the bottom of the left panel.

Storage media built into the Base Unit

– An internal memory
– A hard disk (or high capacity storage), on option. If this option is selected, then the hard disk replaces the internal memory.
– A 3 1/2 in. floppy disk drive, on option (8000 platform only)
– A CD-RW drive, on option (8000 platform only)

External USB storage media

The Base Unit is equipped with 2 USB ports as standard. One of these can be used to connect an external storage medium, in particular a USB memory key.

NOTE

It is possible to disconnect/reconnect this medium while the instrument is switched on. Nevertheless, it is recommended to remove the cursor from the <USBFlash> media in the explorer before removing the key. This will ensure that no data is still currently being transferred.

Although two USB ports are present, it is only possible to use one external USB storage medium per session.

When a file is moved in the explorer of the Base Unit, the end of the move on the screen does not mean that writing of data into the memory is complete. The transcription of some data may still be incomplete if the storage unit is removed prematurely.

NOTE

A beep is emitted by the Base Unit to confirm the successful insertion and recognition of a USB memory key.

Standard Compact Flash card (8000 platform only)

The Base Unit is equipped as standard with a slot in which a Compact Flash card can be inserted.

The Compact Flash card must be inserted before switching on the instrument. It is strongly recommended that this medium should not be withdrawn or reinserted while the instrument is switched on.

Remote Base Unit and data transfer

During a data transfer (with the option Data/Talkset), the distant Base Unit hard drive connected by the fiber is displayed as a storage media. File and directory edition features may all be used in the same manner with this storage media as with the other ones.

Abbreviations for storage media

The abbreviations used in the explorer for the different storage media are:

Abbreviation	Storage medium
harddisk	Hard disk

Abbreviation	Storage medium
disk	Internal flash memory (if no hard disk)
floppy	Floppy disk
cdrom	CD-ROM
usbflash	USB memory key
cflash	Compact Flash memory card
masterdisk	Hard drive from the remote Base Unit which initiated the connection
slavedisk	Hard drive from the remote Base Unit which accepted the connection

Remote hard drives are seen with different names, according to which one has initiated the connection. Nevertheless, possible actions on these disks are all the same. There are no master/slave relations for data exchange/

Directory edit function

The editing functions are similar to those of other explorers. The directories are at the top left of the screen. If the cursor is in this part, the functions proposed by the keys are specific to the management of the directories.

Selection of directories

If the cursor is in the left-hand part of the screen:

– the direction keys can be used to select a directory.

– the key opens the directory selected and closes it when pressed a second time.

Do not confuse "Selected" with "Active". A directory may be displayed in video inverse, to show that it is the current working directory. If it does not have a broken red line round it, it is not active.

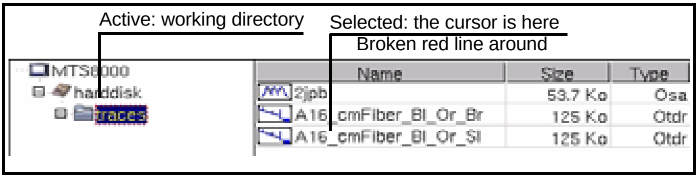


Fig. 90 Selected / Active File

Edition of directories

When a directory is selected, the keys offer the following functions:

<Create Directory> Creation of a new directory. An editor enables entry of its name.

<Rename Dir.> Renames the directory selected. An editor enables replacement of its current name.

<Edit> Opens a new menu providing functions for editing the directories: **Copy**, **Cut**, **Paste**, **Delete** and **Merge**.

NOTE

A whole directory with its contents can be copied into another directory or on to another storage medium.

Using the Merge key, with the txt files from ORL and LTS measurement results.

When saving a Manual ORL or LTS measurement result, in addition to the .LTS and .ORL file, a txt file is automatically saved for each measurement type '(see “File Management” > "Storing results" on page 205).

The key **Merge** is used to merge several txt files from Manual ORL and LTS measurements into one txt file, putting together the results of both measurement types.

– In the explorer, select the txt files generated with the LTS and Manual ORL measurements you want.
– Click on **Merge** key

The file *merged_files.txt* is automatically saved in the same directory as the one where the ORL and LTS txt files have been selected.

> **NOTE**
>
> The file *merged_files.txt* can be renamed once it is saved.

File editing function

The right-hand part of the screen can be used to work on the files in the directory selected.

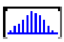
A table gives the list of the files in the directory, showing for each one: its name, size, type and date of creation.

For files recognized by the Base Unit, the types are symbolized by icons. E.g.

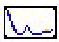
 . OSA file (.OSA extension)

 OTDR file (.SOR extension)

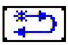
 OEO file (.OEO extension)

 PMD file (.PMD extension)

 CD file (.CD extension)

 AP file (.AP extension)

LTS file (.LTS extension)

 ORL file (.ORL extension)

Format of files

OTDR files that can be read by the Base Unit are type Bellcore 1.0, 1.1 and 2.0.

Other files that can be read by the Base Unit are specific to this instrument.

To read other formats, use JDSU's FiberTrace or FiberCable software.

Easy file selection

The direction keys are used to position the cursor on the file to be selected.

Multiple selection of files

It is possible to select several files simultaneously to move them, delete, print, or copy them on to another medium or to display the corresponding traces in overlay (see "Display of several traces in overlay" on page 237).

To do this, press after each selection. The files selected appear in video inverse. To deselect a file, place the cursor on the name of the file and press the key again.

NOTE

If a mouse is used, click on a file to select it, and click again to deselect it.

If no file has been selected by the key, the file where the cursor is positioned is taken as selected.

On the other hand, if a file has been selected with the key, and the cursor is on another file, the latter is not selected!

Commands relating to files

When a file is selected, the keys offer the following functions:

<Load>	Opens the sub-menu for display of traces. See chapter "Loading files and displaying traces" on page 237
<Select all>	Direct selection of all the files in the directory. After this key has been pressed, its name changes to <Deselect All> so that the operation can be cancelled if necessary.
<Rename File>	Opens the editor to modify the name of the file
<Edit>	Displays a sub-menu to copy, cut, paste delete or merge one or more files.
<Sort>	Opens a sub-menu with which the files in the directory can be sorted by name, size, type or date.
<Send by mail>	This option appears if <Mail> has been defined with a media in the system setup menu. The subject and the recipient of the mail are those set in the file setup menu (see "File expedition" on page 229). Comments may be added. This option allows to send files by e-mail. After a few seconds, a message is displayed to inform the user that the mail has been sent successfully.

Loading files and displaying traces

To access the functions for loading one or more files, select the file(s) in the explorer and press **Load**. Several options are then available:

Simple loading

The key **View Trace(s)** enables simple loading of traces, using the current parameters of the Base Unit. The current trace is then replaced with this new trace.

Load with configuration

The key **Load Trace+Config** will display the traces, recalling the configuration recorded in the file. Thus the zooms, cursors and parameters present at the time of acquisition will be used for the display.

This function also enables to recall and set the parameters defined in the screens corresponding respectively to the **FILE** and **SETUP** keys.

It is then possible to perform an acquisition under the same conditions as those of the trace recalled.

– If the Base Unit was equipped with a different module from the current one when the trace was acquired, then certain configuration parameters cannot be updated. A message then warns the user of this.
– If several traces are selected, the configuration used will be that of the first trace.
– If the number of traces added and the number of traces present is greater than 8, then the last traces added will not all be taken into account.

> The configuration cannot be recalled if the trace was not originally created by a Base Unit.

Display of several traces in overlay

Up to 8 traces in the same application (OTDR, OSA, etc.) can be displayed simultaneously in overlay.

To obtain a display of multiple traces, two methods are possible:

- Select all the files to be loaded at the same time (see chapter "Multiple selection of files" on page 236)
- Add a trace at the same interval as those already displayed by means of the **Add Trace(s)** key.

CD-Rom burning

1. Go to the file explorer
2. Select the directory and/or the files to burn on the CD
3. Click on **Edit**
4. Click on **Copy** or **Cut**

> If you cut the file(s) to save it to on the CD, they will not be on the Base Unit anymore.

5. Click on **CD-R tools**
6. If the CD-Rom is a CD-RW with data to be erased first, click on **Erase CD-RW**, otherwise go to 8
7. A dialog box request to confirm that you want to erase existing data. Click **Yes** to continue

   A new message is displayed to inform you that all data is being erased on the CD-RW.
8. Click on **Burn CD** or **Burn and Close CD**, according to whether you wish to close the session of your CD or not.

   A new dialog box is displayed, asking you to check that the CD-Rom door is securely closed.

   A message is displayed to indicate that you need to wait, the CD-Rom is being burnt.
9. A last message appears a few minutes later to let you know that the CD-Rom has now been successfully burnt Click on any key to remove the message.
10. You may now securely remove the CD-Rom.

Macros

14

The macro function allows to store series of user actions, in order to play them back automatically.

The macro function is operational only while the Base Unit is used under the context of «fiber optic applications», meaning used with one of the following application selected: OTDR, OSA, CD, PMD, AP, LTS...

Actions in the **SYSTEM** page will not be recorded.

A file macro may also be operational with no active modules, as long as «Standalone results» for fiber optics is used, and concerned files are fiber optics files.

The topics discussed in this chapter are as follows:

Calling the Macro function

This function is accessible via the button **SCRIPT**, in the front of the Base Unit.

10 various macros may be created and used.

Once you click on the button **SCRIPT**, you see the list of all the 10 macro positions. Each number from 1 to 10, displays the name of the macro stored at that position, or displays «(Empty)» in case that particular spot is free.

Fig. 91 List of Macros

Macro recording

The Base Unit offers two different types of macro: Standard and File.

For both types, it is required to:

Select and activate all necessary modules before starting the macro recording

> Never press the **SYSTEM** key during macro recording

Standard macro

This macro type shall be used to automate functions or operation mode.

To create a new standard macro:

1. Select a free position. A sub-menu automatically appears.
2. Change the Macro type if necessary to set it on Standard.
3. Click on the soft key **Learn**. You arrive directly to the **Results** page. You can now see the icon at the top of the screen. You are now ready to record.
4. Perform all actions you wish to record in your macro.
5. Click on **SCRIPT** when you are done, and select **End Macro**. You macro has now been saved.
6. Enter the name of your new macro in the text editor and confirm.

> **NOTE**
>
> All events are recorded wether you use the Base Unit buttons, the soft keys, the touchscreen, a mouse, or an external keyboard.

> **NOTE**
>
> The speed of your actions is not really relevant. See "Macro playback" page 244

File macro

This macro type shall be used to perform a template for multiple files.

To create a new file macro:

1. Select a free position. A sub-menu automatically appears.
2. Change the Macro type if necessary to set it on **File**.
3. Click on the soft key **Learn**. You arrive directly to the **FILE** page. You can read the message Load file to start learning at the top of the screen.
4. Select the file you want to work with to perform all actions.
5. Load and view the corresponding trace. You can now see the icon at the top of the screen indicating that you are ready now to record.
6. Perform all actions you wish to record in your macro.
7. Click on **SCRIPT** when you are done, and select **End Macro**. You macro has now been saved.

8 Enter the name of your new macro in the text editor and confirm.

Notes for standard macros also apply for file macros.

Adding interaction to your macro

You may insert in your macro, a special dialog box, a message or a pause. These features will be very useful to you. They will give you some time to switch to another fiber if necessary, let you play a macro to a partial state and stop, or simply just bring your attention after or before a specific action is performed.

To access all these features, click on **SCRIPT** during the learning process of a macro, just like if it was done. Several soft keys will become available.

Inserting a dialog box

Click on the soft key **Insert Dialog Box**. The dialog box editor is displayed. Enter the content of your dialog box and press confirm when you are done.

Inserting a message

Click on the soft key **Insert Message**. The Message text editor is displayed. Enter the content of your message and press confirm when you are done.

NOTE

Dialog boxes and messages serve different purposes when the macro is played back. A message will just appear to bring your attention to a specific point and wait until you are ready to continue. A dialog box will give you the choice between continuing to play the macro, or aborting it, letting you partially play a macro in some cases.

Inserting a pause

Click on the soft key **Insert Pause**. This action will automatically make the macro wait for a user action.

NOTE

During playback, you can see the icon  when a pause is encountered. Press any key to restart the playback.

Renaming a macro

Whether you just created a new macro or you wish to modify the name of an existing macro, you may edit the name and change it as much as you want.

1. Select the macro and select **Name** on the sub-menu.
2. Click on ▶ to open the text editor, and type your name.
3. Click on **Confirm** to accept your new name.

The «Rewrite config» setting

Both your actions and the actual configuration are saved when you create a new macro. So when you play a macro back, you have the choice between:

1. Playing all actions and keeping the actual configuration

Your actions are fairly independent of the configuration, and you don't wish to modify the current configuration: set **Rewrite Config** on **No**.

2. Playing all actions and restoring the original configuration

Your actions are very dependant of the configuration, for example in case you need to do some measurements where you wish to keep all the acquisition parameters the same: set **Rewrite Config** on **Yes.** This setting will also allow to make sure all necessary modules are selected in the **SYSTEM** page before the macro is started.

> ⚠ It is strongly recommended to use the second method where all configuration is restored before playing the macro. Only experienced users might decide to do otherwise for different reasons.

Replacing a macro

Select an existing macro and click on the soft key **Learn**.

A message will be displayed, asking you if you really wish to overwrite the macro. Click Yes if you wish to continue.

Removing a macro

Select an existing macro and click on the soft key **Remove**.

A message will be displayed, asking you if you really wish to delete the selected macro. Click **Yes** if you wish to continue.

Default macro

How to use the default macro

It is possible to set one macro as default. This is very useful if for example, you wish to perform one macro several times in a row. Double clicking on the button **SCRIPT** will automatically play the default macro.

How to set a macro as default

Select **Default Macro**, and choose in the sub-menu, which macro you wish to set as default.

As an alternative, you may also select a macro and press the soft key **Set as default**.

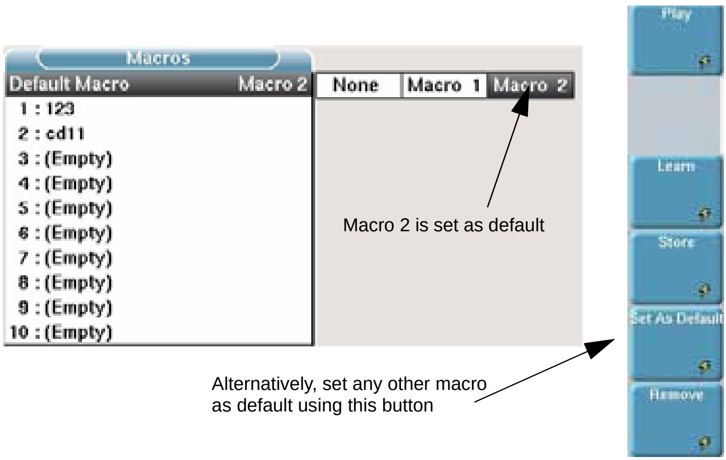


Fig. 92 Default button

Macro playback

To play the default macro, you may directly double click on **SCRIPT**.

To play another macro, go to the macro screen (Click on **SCRIPT** once), and select the macro you wish to play. Then press the soft key **Play**.

During all the play back of the macro, you can see the icon at the top of the screen.

NOTE

This icon changes to when the playback is suspended by a **pause** event, waiting for the user to restart the process (see "Inserting a pause" page 242).

All actions recorded in your macro are now performed.

The speed of the playback is not the same as the speed of the recording. All actions except for acquisitions, will appear faster, but will remain slow enough to let you see what is currently performed. Acquisition times remain the same as during the recording.

NOTE

Don't forget to add interactive events during your macro recording if you need a pause, a specific message or simply to be able to abort the macro at a certain stage if necessary.

Touching a button on the Base Unit will automatically cause the macro playback to abort, except for restarting the playback, interrupted by a **pause** event.

NOTE

For a File macro, you may select several files before you call the Macro function.

Storing a macro

The Base Unit lets you save macros as files on the hard disk or other storage media.

To store a macro, select it and click on the soft key **Store**. It will automatically store it in the current directory.

NOTE

If you wish to store your macro at a specific place on your storage media, make sure you use the file explorer to set that place as your current directory.

To reload this macro later on, go to the file explorer and load the file. The macro will automatically take the first available place in the list of your 10 macros.

> The macro can not be loaded if no macro position is available.

Printer

15

This chapter describes the function, the configuration and use of the Printer module.

> ⚠ This module is only applicable to the 8000 series platform.

The topics discussed in this chapter are as follows:

Function of the printer module

The printer module 82PRINTER brings an internal printer to the 8000 Base Unit.

The printer itself may be completely integrated in the 8000 Base Unit module, or may be fully exposed.

Exposing the printer

In order to load a new paper roll (see "Loading a new paper roll" page 249) or to see clearly the printer normally hidden within the printer module, you may «expose» the internal printer.

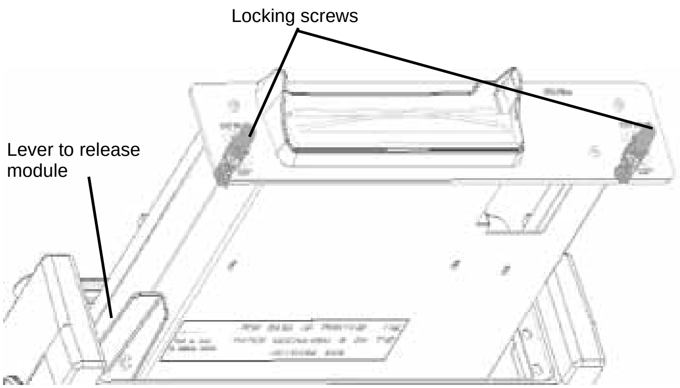


Fig. 93 Exposing the printer out of the module

To expose the printer out of the module:

1 Unscrew the locking screws on each side of the module.

2 Pull on these screws to lift the printer up until you reach the maximum exposed position and hear the click of the lever.

> **NOTE**
>
> You may use the printer in the same manner, whether it is fully integrated in its module or exposed as shown in the figure.

Releasing the printer back into the module.

To release the printer, hold the module while you push on the lever.

> It is important to hold the module while you push on the lever. If you don't, you may stuck your finger and/or damage the internal printer.

Loading a new paper roll

In order to load a new paper roll, proceed as follows:

1. Expose the printer outside of its module (see "Exposing the printer" page 248)
2. Set the lever to position A
3. Insert the paper roll as shown on figure "Loading paper in the printer" page 249)
4. Fold the paper to ease loading
5. Ensure paper is enrolled as shown on figure "Loading paper in the printer" page 249)
6. Pull paper through opening in panel
7. Reset the lever to position C

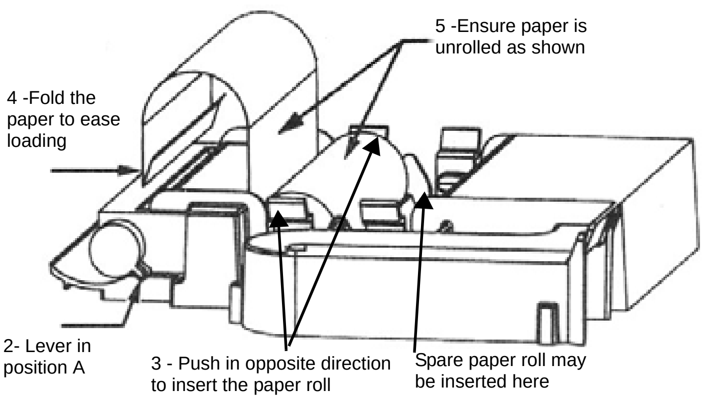


Fig. 94 Loading paper in the printer

Setting up the printer

The printer must be correctly configured in the setup menu: **Printer** must be set to **Internal** or **Internal compressed**.

The Printer icon must be activated in the **SYSTEM** screen, such as shown in figure "Printer activated" page 250.

For both these requirements, you may refer to the 8000 Base Unit manual.

Fig. 95 Printer activated

Printing a page

Before printing a page, make sure you remove the cover and push it back until it holds open.

Press **PRINT**. The page currently displayed will be printing. You can see the icon  at the top of the screen, until the page is finished to be printed.

> Paper used with internal printer is thermo-sensitive and photo-sensitive: Keep your printed documents away from heat and light.

Technical specifications

16

This chapter shows the technical specifications of the OTDR plug-ins of the Base Unit, and options and accessories available.

The topics discussed in this chapter are as follows:

Reflectometer plug-in available

Multimode OTDR plug-in

Wavelength	**850 nm**	**1300 nm**	**850 & 1300 nm**
Multimode modules	5021 MM	5022 MM	5023 MM

The specifications of module 5023 correspond to those of modules 5021 and 5022 for their respective wavelengths.

Single-mode modules

<table>
<tr><th>Wavelength (nm)
Plug-ins</th><th>1310</th><th>1550</th><th>1310 & 1550</th><th>1625</th><th>1550 & 1625</th></tr>
<tr><td>Short distance</td><td>8114 SR/SRe</td><td>8115 SR/SRe</td><td>8126 SR/SRe</td><td></td><td></td></tr>
<tr><td>High resolution
Medium distance</td><td>8114 DR</td><td>8115 DR</td><td>8126 DR</td><td></td><td></td></tr>
<tr><td rowspan="2">High dynamic
Long distance</td><td rowspan="2">8114 HD</td><td rowspan="2">8115 HD</td><td>8126 HD</td><td>8117 HD</td><td rowspan="2"></td></tr>
<tr><td colspan="2">8136 HD</td></tr>
<tr><td>Very high dynamic</td><td></td><td>8115 VHD</td><td>8126 VHD</td><td>8117 VHD</td><td>8129 VHD</td></tr>
</table>

Wavelength (nm) Plug-ins	**1550**	**1310 & 1550**	**1550 & 1625**	**1310 & 1550 1625**
Ultra High dynamic	8115 UHD	8126 UHD	8129 UHD	8136 UHD
Very long distance	8115 VLR	8126 VLR	8129 VLR	8136 VLR

The specifications of modules 8126 (SR, SRe, DR, HD) correspond to those of plug-ins 8114 and 8115 (SR, SRe, DR, HD) for their respective wavelengths. The specifications of module 8129 VHD are those of modules 8115 or 8117 VHD for their respective wavelengths.

Characteristics of reflectometry measurements

Measurement of distance

- Dual cursor
- Distance displayed takes into account the calibration of the refractive index of the fiber.
- Index adjustable from 1,30000 to 1,70000 in steps of 0,00001
- Resolution of display : 1 cm max.
- Resolution of cursor : 1 cm max.
- Spacing of measurement points: from 4 cm, with up to 128 000 acquisition points .
- Accuracy : ± 1 m ±10^{-5} x distance ± resolution of sample (excluding errors of calibration of refractive index of the fiber).

Measurement of attenuation

- Dual cursor
- Resolution of display: 0,001 dB
- Resolution of cursor : 0,01 dB
- Accuracy : ± 0,05 dB /dB ± 0,05 dB.

Measurement of reflectance

- Resolution of display: 0,01 dB
- Accuracy : ± 4 dB.

Automatic measurement

- Automatic measurement of all the elements of the signal. Slope measurement by least squares or 2 points of measurement.
- Display threshold of faults :
  - - 0 to 5.99 dB in steps of 0.01 dB for event thresholds
    - 11 to -99 dB in steps of 1 dB for the reflectance
    - 0 to 1.99 dB/km in steps of 0.001 dB/km for slope.

- Display of slope and attenuation for a segment of fiber.
- Display of the position of a fault and of attenuation.
- Display of the reflectance of the fault.
- Display of ORL

Manual Measurement

- Measurement of slope between the cursors.
- Measurement of attenuation between two segments of fiber.
- Measurement of reflectance of a reflecting element.
- Measurement of ORL between the two cursors.
- Measurement of splice by 2 or 5 points method

Typical specifications of OTDR plug-ins

Multi-mode modules

Typical values, measured at 25°C, unless otherwise indicated:

Plug-ins Multimode		
	5023MM	
	5021MM	**5022MM**
Wavelength[1]	850 ± 20 nm	1300 ± 20 nm
Dynamic[2] with broad pulse	20 dB	18 dB
RMS[3]	25 dB	23 dB
Distance	Up to 80 km	
Pulse width	3 ns to 200 ns	
Event Dead Zone[4] at 3 ns	1.5 m	
Attenuation dead zone[5] at 3 ns	5 m	

1. Laser at 50 ns
2. Specified value corresponding to the one-way difference (in dB) between the level of back-diffusion extrapolated at the beginning of the fiber and the level containing 98% of noise, after 3 minutes of averaging.
3. Typical value corresponding to the difference (in dB) between the level of back-diffusion extrapolated at the beginning of the fiber and the RMS noise level, after 3 minutes of averaging.
4. Measured at 1.5 dB below the peak of a non-saturated reflecting event
5. Measured at +/- 0.5 dB on the basis of a linear regression from a reflectance of type FC/PC.

Single-mode modules

Typical values, measured at 25°C, unless otherwise indicated:

Plug-ins Monomode

Plug-ins	Short distance	High resolution Middle distance	High dynamic Long distance		Very high dynamic Long distance		Ultra High Dynamic Long distance	Very Long Range
	8114/15/26 SR/ SRe	8114/15/26 DR	8114/15/ 26/36 HD	8117/36 HD	8114/15/ 26 VHD	8129 VHD	8115/26/36/29 UHD	81xx VLR
Wave-length[1]	1310 / 1550 ± 20 nm	1310 / 1550 ± 20 nm	1310 / 1550 ± 20 nm	1625 ± 10 nm	1310 / 1550 ± 20 nm	1550 ± 20 nm/1625 ± 10 nm	1310 ± 20 nm 1550 ± 20 nm 1625 ± 10 nm	1310 ± 20 nm 1550 ± 20 nm 1625 ± 15 nm
Dynamic[2] with broad pulse	27,5 / 25 dB	31 /29 dB	36,5 / 35 dB	35 dB				
RMS[3]	SR: 35 / 33 dB SRe: 34 / 32 dB	37 / 35 dB	42 / 40 dB	40 dB	44 dB		45.5 / 50 / 45.5 dB[4]	45 / 43,5 / 42,5 dB
Distance	up to 260 km		up to 380 km				up to 380 km	up to 380 km
Pulse width	10 ns to 10 µs	5 ns to 10 µs	10 ns to 20 µs		10 ns to 20 µs		10 ns to 20 µs	3ns to 20 µs
Event Dead Zone[5]	(at 10 ns) 3 m	(at 5 ns) 1 m	(at 10 ns) 4 m		(at 10 ns) 6 m		(at 10 ns) 4,5 m	(at 3 ns) 0,8 m
Attenua-tion Dead Zone[6]	25 m	8 m	15 m		20 m		15 m	5 m

1. Laser at 10 µs and 25° C
2. Specified value corresponding to the one-way difference (in dB) between the level of back-diffusion extrapolated at the beginning of the fiber and the level containing 98% of noise, after 3 minutes of averaging.
3. Typical value corresponding to the difference (in dB) between the level of back-diffusion extrapolated at the beginning of the fiber and the RMS noise level , after 3 minutes of averaging.
4. at 20 µs pulse width with Non Zero Dispersion Fibers in single wavelength configuration.
5. EDZ measured at 1.5 dB below the peak of a non-saturated reflecting event at minimum pulse width.
6. ADZ measured at +/+/- 0.5 dB on the basis of a linear regression from a reflectance of type FC/PC (-50 dB) at minimum pulse width.

Classes of the lasers of the OTDR plug-ins

Module Standard	EN 60825-1, Ed. 1.2, 2001-08	FDA21CFR§1040.10
Multi-mode **MM** - at 1300 nm - at 850 nm	Class 1M Class 1	Class 1 Class 1
Single-mode **SR, SRe,DR**	Class 1	Class 1
Single-mode **HD, VHD, UHD, VLR** - at 1310 nm - at 1550 and 1625 nm	Class 1M Class 1	Class 1 Class 1

Ranges

Ranges for MM modules

	3 ns	20 ns	50 ns	200 ns
0.5 km	X	X	X	
1 km	X	X	X	X
2 km	X	X	X	X
5 km	X	X	X	X
10 km	X	X	X	X
20 km	X	X	X	X
40 km		X	X	X
80 km				X

Ranges for SR and SRe modules

	10 ns	30 ns	100 ns	300 ns	1 µs	3 µs	10 µs
2 km	x	x	x				
5 km	x	x	x	x			
10 km	x	x	x	x	x		
20 km	x	x	x	x	x	x	
40 km	x	x	x	x	x	x	x
80 km			x	x	x	x	x
140 km				x	x	x	x
260 km							x

Ranges for DR plug-ins

	5 ns	20 ns	100 ns	300 ns	1 µs	3 µs	10 µs
2 km	x	x	x				
5 km	x	x	x	x			
10 km	x	x	x	x	x		
20 km	x	x	x	x	x	x	
40 km		x	x	x	x	x	x
80 km			x	x	x	x	x
140 km				x	x	x	x
260 km					x	x	x

Ranges for HD plug-ins

	10 ns	30 ns	100 ns	300 ns	1 µs	3 µs	10 µs	20 µs
5 km	x	x	x	x				
10 km	x	x	x	x	x			
20 km	x	x	x	x	x	x		
40 km	x	x	x	x	x	x	x	x
80 km	x	x	x	x	x	x	x	x
140 km		x	x	x	x	x	x	x
260 km				x	x	x	x	x
380 km							x	x

Ranges for VHD and UHD plug-ins

	10 ns	30 ns	100 ns	300 ns	1 µs	3 µs	10 µs	20 µs
5 km	x	x	x	x				
10 km	x	x	x	x	x			
20 km	x	x	x	x	x	x		
40 km	x	x	x	x	x	x	x	x
80 km	x	x	x	x	x	x	x	x
140 km		x	x	x	x	x	x	x
260 km				x	x	x	x	x
380 km						x	x	x

Ranges for VLR plug-ins

	3 ns	30 ns	100 ns	300 ns	1 µs	3 µs	10 µs	20 µs
5 km	x	x						
10 km	x	x	x					
20 km	x	x	x	x	x			
40 km	x	x	x	x	x	x	x	x
80 km	x	x	x	x	x	x	x	x
140 km		x	x	x	x	x	x	x
260 km				x	x	x	x	x
380 km							x	x

Dimensions and weight of OTDR measurement plug-ins

Weight : approx. 500 g (1.1 lbs)

Dimensions (in mm, without front panel) :

– Width : 120
– Height :27
– Length : 211

WDM plug-ins

Typical specifications of WDM plug-ins

Typical specifications, measured at 25°C, unless otherwise indicated.

	Plug-in 81WDM Module S+C+L	Plug-in 81WDMPMD module O+E+S+C+L
Wavelength		
Range	1485-1640 nm	1260-1640 nm
Duration of sweep (in real time)	1.5 s	3s

	Plug-in 81WDM Module S+C+L	**Plug-in 81WDMPMD module O+E+S+C+L**
Accuracy [1]	± 10 pm	
Resolution of display	1 pm	
Minimum interval between channels	10 GHz (80 pm)	
Optical Bandwidth (FWHM)[2]	30 pm	
Power		
Range of display	- 90 dBm at + 30 dBm	
Resolution of display	0,01 dB	
Channel measurement range[3]	- 79 dBm at + 10 dBm	
Noise floor[4]	-86 dBm	
Max. permissible power, before signal cut off: - total - per channel	 + 20 dBm + 10 dBm	
Accuracy in power [5]	± 0,5 dB max	
Linearity[6]	± 0,2 dB	
Flatness[7]	± 0,2 dB	
Dependence on polarization	± 0,05 dB	± 0,15 dB
ORL (Optical Return Loss)	35 dB	
ORR (Optical Rejection Ratio)[8]	35 dB at 50 GHz from the carrier 40 dB at 100 GHz from the carrier	

1. from -40 dBm to +5 dBm, in the range of 1525-1620 nm
2. in the range of 1525-1570 nm
3. @ 1550 nm, with averaging, -75 dBm without averaging
4. @ 1550 nm, with averaging, -81 dBm without averaging
5. at -30 dBm and 1550 nm, excluding the uncertainty relating to the input connector .
6. @ 1590 nm from 0 to -40 dBm
7. in the range of 1525 nm - 1620 nm (reference : 1550 nm)
8. on the basis of the peak of a single carrier, on the band 1530 nm - 1605 nm, at 0 dBm and with max. resolution

Dimensions and weight of WDM measurement plug-ins

Weight : approx. 500 g (1.1 lbs)

Dimensions (in mm, without front panel) :

– Width : 120
– Height :27
– Length : 211

PMD plug-ins

Typical values, measured at 25°C, unless specified otherwise.

Plug-in	**81PMD**	**81WDMPMD**
Measurement time[1]	6 seconds (independent of the PMD value)	
Dynamic range	Up to 45 dB	
DGD		
Measurement range	0.080 ps to 60 ps[2]	
Uncertainty	± 0.020 ps / + 2% PMD[3]	
Repeatability	0.025 ps[4]	

1. within 1485-1640 nm, without averaging
2. up to 150 ps for weak coupling
3. weak coupling for 0.1 ps to 60 ps DGD range, up to 35 dB budget loss - traceable to NPL standard
4. weak coupling for 0.1 ps to 60 ps DGD range, up to 35 dB budget loss - traceable to NPL standard

CD modules

Typical specifications of CD module

Typical values, measured at 25°C, unless otherwise specified.

CD specifications	Module 5083 CD
Measurement time Manual Auto throughout the wavelength range	from 30 s
Dynamic[1]	up to 120 km
Minimum distance[2]	10 km
Wavelength	1255 to 1650 nm
Absolute accuracy of wavelength	+/- 0.1 nm
Repeatability of dispersion coefficient[3]	+/- 0.2 ps/(nm*km)
Dispersion range	0.1 ps at 100 ps/(nm*km)
Repeatability of dispersion slope	+/- 1%

1. with automatic measurement and termination connector, 3-point measurement
2. on a non-saturated Fresnel
3. at 1550 nm, on a G652 fiber 75 km long

Source specifications	Module 5082 CD			
Wavelength (DFB lasers)	1310 ± 5 nm	1480 ± 5 nm	1550 ± 5 nm	1625 ± 5 nm
Spectrum width	< 10 pm			
Power stability over 24 h[1] Output power, calibrated	± 0,10 dB			
Output power, calibrated	1.5 dBm	3 dBm	3 dBm	3 dBm
Output power, Variable	-10 dB with respect to calibrated power			

1. after 15 minutes pre-heating

Laser class of source of CD modules

At 1310, 1480, 1550, 1625 nm: laser class 1.

Spécifications du réflectomètre	**Module 5083 CD**			
Wavelength (DFB lasers)	1310 ± 5 nm	1480± 5 nm	1550± 5 nm	1625 ± 5 nm
CEI dynamic (guaranteed)[1]	35 dB	33 dB	32,5 dB	33 dB
Dynamic RMS (typical)[2]	39 dB	38 dB	37 dB	37 dB
Distance	380 km			
Pulse width	10 ns to 20 µs			
Dead Zone[3] - Event (EDZ) - Attenuation (ADZ)	6 m max. 30 m			

1. Specified minimum value corresponding to the one-way difference (in dB) between the level of back-diffusion extrapolated at the beginning of the fiber and the level containing 98% of noise, after 3 minutes of averaging.
2. Typical value corresponding to the difference (in dB) between the level of back-diffusion extrapolated at the beginning of the fiber and the RMS noise level, after 3 minutes of averaging.
3. Value with the shortest pulse:

EDZ measured at 1.5 dB below the peak of a non-saturated reflecting event

ADZ measured at +/- 0.5 dB on the basis of a linear regression from a reflectance of type FC/APC (-50 dB).

Information on «fiber» plug-ins 5020TF and 82LFSM2 / 82LFSM4

5020TF plug-in

The 5020 TF single-mode and multi-mode modules contain two reels of fiber for use with a reflectometer. They are intended for training and demonstration and can be used as launch cable.

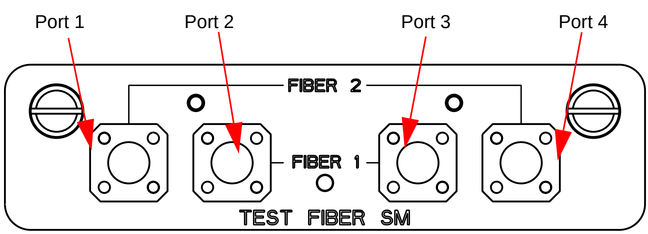


Fig. 96 Front panel of a «fiber» plug-in (ex 5020TF/SM)

> **NOTE**
>
> As these plug-ins are not test instruments, they are not supplied with a certificate of calibration.

	Module 5020TF/MM (Multimode)	**Module 5020TF/SM (Single-mode)**
Type of fiber used	Corning MM	Corning SMF 28
Recommended group indices	1.50140 @ 850nm ; 1.49660 @ 1310nm	1.46750 @ 1310nm ; 1.46810 @ 1550/1625nm
Length of fiber 1 Length of fiber 2	300 ± 30 m 300 ± 30 m	466 ± 23 m 1000 ± 50 m
Attenuation of connectors	0.5 dB [1]	

1. Guaranteed at 1625 nm except for port 1 of fiber 2, connectors cleaned, in good conditions.

Recommendations for using fiber 2 (long fiber)

The attenuation per unit length of fiber 2 may be higher near port 1 :

– when measuring a dead zone it is preferable to connect the reflectometer to port 4.

– when measuring insertion loss of a connector situated after the launch cable, it is preferable to connect the reflectometer to port 1.

82LFSM2 / 82LFSM4 plug-ins

82LFSM2 / 82LFSM4 plug-ins contain one reel of singlemode fiber with two jumpers, to be used as a launch or receive cable with an OTDR. These plug-ins can also be used for demonstration and training purpose.

> **NOTE**
>
> As these plug-ins are not test instruments, they are not supplied with a certificate of calibration.

	82LFSM2	**82LFSM4**
Type of fiber used	Corning SMF 28 or SMF 28e	
Recommended group indices	1.4677 @ 1310nm and 1.4682 @ 1550/1625nm	

	82LFSM2	82LFSM4
Length of fiber	2 km -0.02/+0.11 km	4 km -0.03/+0.21 km
Attenuation of connectors	< 0.5 dB[1]	

1. Connectors cleaned, in good conditions

MTAU plug-ins

All specifications are given at 25°C, excluding connectors.

Plug-in	81MTAU2	81MTAU3
Wavelength range (nm)	1260 - 1640	
Insertion Loss (max dB)	1	1.5
Return Loss (max dB)	50	
PDL[1] (max dB)	0.1	
Repeatability[2] (max dB)	0.01	

1. Polarization Dependent Loss
2. At constant temperature and polarization

BBS plug-ins

Specifications, measured at 25°C, unless otherwise mentioned.

Parameter	81 BBS1	81 BBS2
Wavelength range	1480 - 1640 nm	1260 - 1640 nm
Minimum spectral density (dBm / 0,1 nm)	-42 [1]	-42 [2]
Minimum spectral density (dBm / nm)	-32 [a]	-32 [b]
Output power (dBm)	> 4	> 8
Polarisation extinction ratio (dB)	> 10	> 10 [3]
Power consumption (Wh)	4	10

Parameter	81 BBS1	81 BBS2
Operating temperature range (°C)	-5 to 45°C	-5 to 45°C

1. over 1480 - 1600 nm wavelength range
2. over 1270 - 1600 nm wavelength range
3. for each of the three SLEDs independently.

OFI plug-ins

There are preliminary specifications for the OFI 81xx.

Bi-directional loss specifications.

Specifications, measured at 25°C

NOTE

This applies to the 81xx OFI modules.

To ensure optimal use (bi-directional measurement and communication), two units are required.

Source function (also valid for source mode)	81xx OFI Module
Laser type	Class 1 laser
Wavelength at 25° C	1310+/-20 nm, 1490+/-3 nm, 1550+/-30 nm, 1625+/-5 nm
Nominal output level into 9/125 µm fiber (CW mode)	- 3.5 dBm
Modulated output level	3 dB lower
Level stability	
Short term 15 min (ΔT = +/- 0.3 K)[1]	+/- 0.02 dB
Long term 8 hours (ΔT = +/- 3 K)[1]	+/- 0.2 dB

1. After 15 min warm up

Bidirectional loss function (FOX port)	81xx OFI Module
Dynamic range	60 dB
Accuracy[1] Loop back Side-by-side	 +/-0.25 dB without optical connection uncertainty +/-0.15 dB without optical connection uncertainty
Display resolution	0.01 dB
Type of detector	InGaAs
Type of fiber	9 µm
Precision of length measurement	+/- 1.5% (3 to 200 km)

1. After 15 minutes warm up.

Optical Return Loss	81xx OFI Module
ORL measurement display range	Up to 65 dB
Display resolution	0.01 dB
Accuracy	tbd

Standalone power meter

Standalone power meter functions	**81xx OFI Module**
Wavelength range (adjustable per 1 nm)	800 to1650 nm
Selectable wavelength	850 / 980 / 1300 / 1310 / 1420 / 1450 / 1480 / 1490 / 1510 / 1550 / 1625 nm and one user-defined
Auto-λ detection (if signals are emitted by a JDSU source)	850 / 1310 / 1490 / 1550 / 1625 nm
Detected modulation	270 Hz, 330 Hz, 1 kHz, 2 kHz

	Standard	**High Power**
Display range	+10 to -60 dBm	+26 to -55 dBm
Accuracy	+/- 0.2 dB (+5 dBm to -50 dBm)	+/- 0.25 dB (+23 dBm to -50 dBm)
Detector type	Ge	Filtered InGaAs, 2 mm
Display resolution	0.01 dB	
Type of fiber	9 µm to 50 µm	

Warning

Warning for 82PRINTER module, 81WDM, 81PMD, 81WDMPMD and UHD and VLR plug-ins:

These are class A products. In a domestic environment, theses products may cause radio interference in which case the user may be required to take adequate measures.

Options and accessories

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This chapter describes all the accessories and options available with the MTS / T-BERD series.

The topics discussed in this chapter are as follows:

References of measurement plug-ins

OTDR plug-ins[1]	**Reference**
Short distance 34 dB 1310 nm	E8114SRe
Short distance 32 dB 1550 nm	E8115SRe
Short distance 34/32 dB 1310/1550 nm	E8126SRe
Short distance 35 dB 1310 nm	E8114SR
Short distance 33 dB 1550 nm	E8115SR
Short distance 35/33 dB 1310/1550 nm	E8126SR
Medium distance 37 dB 1310 nm	E8114DR
Medium distance 35 dB 1550 nm	E8115DR
Medium distance 37/35 dB 1310/1550 nm	E8126DR
Long distance 42 dB 1310 nm	E8114HD
Long distance 40dB 1550 nm	E8115HD
Long distance 42/40 dB 1310/1550 nm	E8126HD
Long distance 40 dB 1625	E8117HD
Long distance 42/40/40 dB 1310/1550/1625 nm	E8136HD
Very long distance 44 dB 1310 nm	E8114VHD
Very long distance 44 dB 1550 nm	E8115VHD
Very long distance 44/44 dB 1310/1550 nm	E8126VHD
Very long distance 44 dB 1625 nm	E8117VHD
Very long distance 44/44 dB 1550/1625 nm	E8129VHD
Ultra long distance 1550 nm	E8115UHD
Very long distance 1310/1550 nm	E8126UHD
Very long distance 1550/1625 nm	E8129UHD
Very long distance 1310/1550/1625 nm	E8136UHD

1. Supplied with its manual E8100M0X (X depends on language)
Specify optical connector of each OTDR plug-in
*Oblique universal connector not available on 812XMM OTDR plug-ins

OTDR plug-in for calibration reports	Reference
OTDR plug-in for calibration ratios	E81OTDRCR

VLR, OTDR plug-in	Reference
Very Long Range 45 dB 1310 nm OTDR plug-in	8114 VLR
Very Long Range 43 dB 1550 nm OTDR plug-in	8115 VLR
Very Long Range 43 dB 1625 nm OTDR plug-in	8117 VLR
Very Long Range 43 dB 1625 nm OTDR plug-in with filter	8117R VLR
Very Long Range 1383 nm OTDR plug-in	8118 VLR
Very Long Range 1490 nm OTDR plug-in	8118 VLR 49
Very Long Range 45/43 dB 1310/1550 nm OTDR plug-in	8126 VLR
Very Long Range 43/43 dB 1550/1625 nm OTDR plug-in	8129 VLR
Very Long Range 45/43/43 dB 1310/1550/1625 nm OTDR plug-in	8136 VLR
Very Long Range 45/43/43 dB 1310/1490/1550 nm OTDR plug-in	8138 VLR 49
Very Long Range 45/43/43 dB 1310/1383/1550 nm OTDR plug-in	8138 VLR 38
Very Long Range 45/43/43 dB 1310/1383/1550 nm OTDR plug-in	8148 VLR 83
Very Long Range 42/40/40/40 dB 1310/1490/1550/1625 nm OTDR plug-in	8148 VLR 49

WDM plug-ins	Reference
WDM plug-in Band S+C+L	E81WDM

PMD plug-ins	Reference
PMD Plug-in Band S+C+L	E81PMD
PMD + AP + WDM plug-in Band O+E+S+C+L	E81WDMPMD

PMD accessories	Reference
Optical variable polarizer (not necessary for 81XXX plug-ins)	EOVP-15
Broadband source for PMD measurements	EOBS-15

CD plug-ins	Reference
OTDR/CD module 1310/1480/1550/1625 - 35 dB	E5083 CD + E50otdrExt

CD options	Reference
Sources 1310/1480/1550/1625 DFB	E508X/LS

CD accessories	Reference
Termination connector FC/PC & APC	ETERM/CD/FC
Termination connector SC/PC & APC	ETERM/CD/SC
Termination connector ST/PC	ETERM/CD/ST
Termination connector E2000/HR&HRL	ETERM/CD/E2000

MTAU plug-ins, 8100 series	Reference
Multi Test Access Unit offering 2 input ports	E81MTAU2
Multi Test Access Unit offering 3 input ports + 1 mirror	E81MTAU3

OFI plug-ins	Reference
1310/1550nm OFI plug-in module - standard power	E8126OFI1
1310/1550nm OFI plug-in module - high power	E8126OFI2
1310/1550/1625nm OFI plug-in module - standard power	E8136OFI1
1310/1550/1625nm OFI plug-in module - high power	E8136OFI2
1310/1490/1550nm OFI plug-in module - standard power	E8132OFI1
1310/1490/1550nm OFI plug-in module - high power	E8132OFI2

OFI Module option	**Reference**
ORL option for OFI plug-in module with mandrel	E81OFIORL

Application software	**Reference**
Optical Fiber Trace Software for post-analysis	EOFS100
Optical Fiber Cable Software Cable for Acceptance report generation	EOFS200

BBS plug ins	**Reference**
BroadBand Source plug-in 1480/1640 nm	E81BBS1
BroadBand Source plug-in 1260/1640 nm	E81BBS2

Internal Printer modules, 8100 series	**Reference**
Internal Printer Module	E82PRINTER

Launch fiber modules for OTDR demo and test [1]	
Launch cable singlemode (1 fiber G652 - 2km)	E82LFSM2
Launch cable singlemode (1 fiber G652 - 4 km)	E82LFSM4

1. Two optical connectors must be specified when ordering each launch fiber module.

User manual references

User manuals for MTS/T-BERD plug-ins	
User manual for modules, 8100 series (French)	E8100M01
User manual for modules, 8100 series (English)	E8100M02
User manual for modules, 8100 series (German)	E8100M03

References of optical connectors and adapters

Optical connectors for plug-ins[1] **OTDR Single-mode and WDM Fixed Connector**	
FC/PC Connector	EFCPC
FC/APC Connector (only for single-mode)	EFCAPC
E2000 Connector (only for single-mode)	EE2000
E2000/HRL Connector (only for single-mode)	EE2000HRL

1. A Connector (fixed or universal) must be specified at time of order

Front Panel Optical Connectors for plug-ins[1] **Single-mode Universal OTDR and WDM Connector**	
Universal PC Connector with FC adapter	EUNIPCFC
Universal PC Connector with SC adapter	EUNIPCSC
Universal PC Connector with ST adapter	EUNIPCST
Universal PC Connector with DIN adapter	EUNIPCDIN
Universal PC Connector with LC adapter	EUNIPCLC
Universal APC Connector for SM only with FC adapter	EUNIAPCFC
Universal APC Connector for SM only with SC adapter	EUNIAPCSC
Universal APC Connector for SM only with ST adapter	EUNIAPCST
Universal APC Connector for SM only with DIN adapter	EUNIAPCDIN
Universal APC Connector for SM only with LC adapter	EUNIAPCLC

1. A connector (fixed or universal) must be specified at time of order of the plug-in

Additional Adapters for Universal Connectors[1]	
Universal FC Adapter	EUFCAD
Universal SC Adapter	EUSCAD
Universal ST Adapter	EUSTAD
Universal DIN Adapter	EUDINAD
Universal LC adapter	EULCAD

1. Interchangeable in the field

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